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Misconceptions Regarding Slotted Conduits.

[Written for the ELECTRICAL REVIEW, by THOMAS WHITESIDE RAE.]

It is only natural that these should exist on many points, and, perhaps, equally natural that popular apprehensions should be chiefly excited by the conviction of a defect that does not really exist.

The drainage problem, as connected with conduits, while of paramount importance, is generally regarded from a mistaken standpoint, giving rise to needless confusion and radical misapprehension of the question.

For example: The greatest recorded tropical rainfall in 24 hours is stated to have been 25.5 inches, and to have occurred at Khassaya, India. For purposes of comparison, it may be equivalently expressed as 0.018 inches per minute. While there is no reason to doubt this, it could be verified only with considerable trouble and delay, and the records of the signal office of the U. S. War Department, in the 19 years of its lifetime, instances as the maximum diurnal fall, 22.27 inches, at Alexandria, La., on June 16, 1886, practically 0.016 inches per minute, and, among a number of cases of excessive fall for a short period, one at Biscayne, Florida, of 4.1 inches in 30 minutes, as the maximum. This would be at the rate of 0.136 inches per minute, and being the most aggravated case known to have occurred in this country, it will be of interest to consider a conduit subjected to such conditions and deduce from the foregoing data their influence upon it.

Take, for example, one mile of conduit (63,360 inches) with an interior diameter of 10 inches and a slot three-fourths of an inch wide. The area open to rain fall will be 47,520 square inches, and the total quantity of rain passing through it under the specified condition, viz; 4.1 inches in 30 minutes—will be 195,832 cubic inches; or 878 U. S. gallons nearly. It is gratuitous to devote consideration to the possibilities of disposing of such an amount of water in the distance of one mile, but simply for the sake of illustration, let it be assumed that a mile of level conduit has its drains stopped temporarily during such a rainfall and the depth of water in the unrelieved conduit for a given time, for example, 30 minutes, be calculated.

By reference to the outlined section of a conduit introduced in the text, the following is readily apparent:

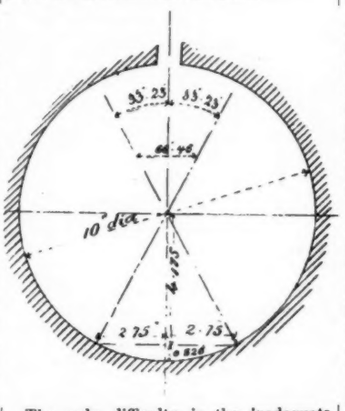
The cross section, in one mile of level conduit, of the prism of water resulting from 4.1 inches of rainfall in 30 minutes, with no escape whatever by drainage, is:

$$\frac{\text{Cubic inches entering} = 195,832}{\text{Linear " in 1 mile} = 63,360} = 3.0959 \text{ square inc's}$$

and its depth, measured on the vertical diameter of the conduit, 0.825 inches.

The method of solution is tentative, and, consequently, tedious, and to save time, the angle of the "wet arc"—as the portion of the periphery touched by the water is termed—is admitted to be 66° 46'. Bearing in mind that the area of complete cross section of the assumed conduit is 78.54 square inches, and that the area of a sector bears the same ratio to that of the full circle as the length of its arc—in degrees, etc.—bears to the entire circumference of 360°, the reasoning at once becomes evident. Furthermore, inspection of the outline figure will render unnecessary any explanation of the resort to half arcs in calculating. The statement is as follows:

Interior diameter of conduit = 10 inches.
Wet arc = 66°—46'.
Ratio of wet arc to interior circumference of conduit = 5.30.
Transverse area of conduit = 78.54 square inches.
Transverse area of sector 66° 46' = 14.57 square inches.
Transverse area of triangle bounded by radii and chord of 66° 46' = 11.48 square inches.
Transverse area of segment of 66° 46' (sector less triangle) = 3.09 square inches.
Sin. half arc (33° 23') = 0.55024 = 2.75 inches.
Cosin. half arc (33° 23') = 0.83501 = 4.175 inches.
Ver. sin. half arc (1—cos) = 0.16499 = 0.825 inches.
Depth of water in conduit = 0.825 inches.



The only difficulty is the inadequate drainage of the streets through which the conduit may pass. If this is ample, it is a trifle for the conduit to dispose of its own share of the rainfall, but if it also has to act as a public sewer, the size necessary for its conductive purpose alone must be proportionately increased.

The trouble is not with the conduit but with its environment, and, with street drainage of the modern approved standard, no rain that ever fell could incapacitate or interfere with a slotted conduit.

Electricity For Fibroid Tumor.

The following conclusions are taken from an editorial on the use of electricity in the treatment of fibroid tumors, which appeared in the *Journal of the American Medical Association*:

1. Electricity will relieve the pain due to pressure and sympathetic disturbances in the majority of fibroid tumors treated by that agent, in from one to six applications.

2. Hemorrhage due to fibroids can be relieved by the positive galvano-caustic applications of electricity in all cases in which a sufficiently concentrated dose can be applied to the greater portion of the endometrium.

3. A large percentage of tumors of enormous size can be checked in growth, and often reduced in size, by an intelligent and persistent application of this agent, while tumors of medium and smaller size can be markedly reduced, and, in a few instances, be made to totally disappear.

4. The majority of patients, while under this form of treatment, improve rapidly in general health, from the characteristic tonic effect exerted upon the whole system.

5. According to the only statistics given, 84 per cent. of patients submitted to the treatment are symptomatically relieved, four per cent. absolutely cured, while 12 per cent. are not benefited, or failed to make a fair test of the treatment.

6. The treatment is not by any means painless in a large number of cases, although an anæsthetic is seldom resorted to. A well-tried system of concentration, however, has been adopted, by which, as a rule, all the benefits of the agent can be obtained, without transcending the toleration of the patient.

The Bain Motor-Dynamo.

We are able to present the following facts regarding Mr. Foree Bain's motor-dynamo which we illustrated last week. The cut was made from a seven horse-power motor recently installed in the Chicago Paper Company's warehouse. It is used to operate a large freight elevator and a paper cutting machine. It is entirely satisfactory to the purchasers, a test reported a short time ago showing an efficiency of 95½ per cent.

The field magnets consist of two shafts of Norway annealed iron, one on either side of the armature, equal in length to the total height of the motor. These are clamped at either end by the double yoke pieces and midway between by very heavy pole pieces, thus securing a maximum contact between the pieces. The field is the "consequent pole" type, with two paths for the magnetic circuit.

The pole pieces are of equal size and weight and consequently of equal magnetic density, therefore, the armature is not pulled harder against one side of the bearing than another, but floats in a field in which the magnetic lines are equal and properly distributed. The double magnetic circuits are extremely short. The coils are wound on spools and slipped over the cores; the spools are only three inches long on this size motor. There is absolutely no loss of magnetism due to false poles, usually produced by bad contacts in field magnet joints. The bearings are self oiling.

The armature produces 1.4 volts per foot active wire, with inductor velocity of 48 feet per second. The field is maintained with less than one half an ampere, or 1¾ per cent. of the total current, and a density of about 600 amperes per square inch. The conductors on the armature are figured at a density of 2,700 amperes per square inch. The field resistance is nearly 1,300 times higher resistance than the armature. The motor runs quietly and very near constant speed with variable load.

Mr. Bain calls this type machine his motor-dynamo, not that it is a separate motor and dynamo combined in one machine, but that it may be used as either a motor or dynamo. His machines show equal efficiency when they are used as dynamos. He builds this type machine in sizes from 5 to 100 horse-power, the larger sizes have a peculiar compounding, one of his late inventions, which will be illustrated at another time.

Association of Railway Telegraph Superintendents.

The ninth annual meeting of the Association will be held at the Cataract House, Niagara Falls, N. Y., on Wednesday, June 18, 1890.

The support given to the Association by leading railroads, and the success with which it has been attended since its formation (November 20, 1882), in elevating the standard of employés and eliminating those of objectionable records from the service, has been very gratifying.

This meeting is expected to be one of the most important yet held, it having been arranged for the reading of papers on various topics—semaphore signals, electric devices, etc. It is, therefore, desired that as many railroads as possible be represented.

Any officer in charge of operators is eligible on the payment of $3.00 membership fee, which includes all dues for the year.

Electric Light Station Insurance.

BY S. E. BARTON, BEFORE THE BOSTON ELECTRIC CLUB.

At the annual meeting of the National Board of Fire Underwriters, in New York, on the 8th of this month, several very interesting papers upon important topics affecting the welfare or illfare of the business were presented.

An extract from the reports of that meeting reads as follows:

"The most interesting report came from the committee on lighting and heating, read by Chairman John H. Washburn. The great problem before us to-day, he said, is the management of the various systems of electric lighting, which is not the harmless thing we had imagined, but a most prolific source of danger. It has come to stay, however, and in time it will probably be as safe as any light in use. With the report a graphic diagram was handed in, which showed that while electric wires and lights were responsible for losses of only $460,000 in 1886, the value of property injured by fire which could be traced to the same source, in 1889, was $5,533,000."

Such a report, coming from a body representing, as its name implies, the fire underwriters of the nation, conveys to the public the idea that "the relation between fire insurance and electric interests from the underwriters' standpoint," is a very gloomy one for the former.

I was sorry to see such a bold statement go forth without any explanation as to how it was arrived at or what it indicated. If it was intended to indicate, as it certainly does, to every person not acquainted with the facts, that the danger of fire from electrical causes had grown to be 12 times greater in 1889 than it was in 1886, it is shamefully unfair, because it is untrue.

As the figures given are identical with those contained in the "Chronicle Fire Tables," published by the Chronicle Company, of New York, I presume they came from that publication, and, therefore, it is fair for me to draw from the same source to show how unfair the report really is.

Those tables show that in 1886 there were 29 fires from "electric wires and lights," causing loss of $460,000; in 1887, 66 fires and $681,000 loss; in 1888, 91 fires, with $1,587,000 loss; in 1889, 74 fires, with $5,533,000 loss.

The yearly increase in the *number* of fires reported is nowhere near the percentage of increase in the use of electric lights and wires, and, therefore, the number of fires was not used to show the comparative hazard by years. It looked much more startling to use the amount of loss, and for that reason I presume it was used; I can see no other reason for using it. But where did the great increase in amount of loss come from? Why, from the Boston fire of last Thanksgiving Day, which "everybody says was caused by the electric wires," but which *nobody* has proved.

The fire marshal in his investigation exhausted his energies and all means at his disposal, and certainly the bulk of the testimony taken would naturally lean towards fixing it upon the electric wires. The Massachusetts Insurance Commissioner, in his 1889 Report, just issued, says "the preponderance of the testimony seems in favor of the theory that it was caused by the electric wires;" therefore, in his opinion (which is good enough for me), it is a "theory" that confronts us and not a condition nor a fact. That loss amounted to about three millions and a half. It was injected into the destruction account of "electric wires and lights," making the account four times as large as in 1888, and yet, admitting the right to charge one fire to that account at all, it only in-

creased the number of accidents by one. Supposing the fire had got still further beyond the control of the firemen and had destroyed one hundred millions, instead of three and a half? Of course it would have proved (according to the logic of the Report of the National Board) that electricity is 22 times as hazardous as the report makes it out to be.

The official return of the big fire at Lynn says it was caused "by a draft from an open door blowing the blaze from an oil stove down around the burner, causing the stove to explode." The loss by that fire was about four and one half millions, and I presume it should be charged in equal proportion to open doors, drafts and oil stoves.

Two fires were reported in Massachusetts last year as caused by "reflected rays of the sun." If they had destroyed five and a half millions of property, the combination of the sun and a reflecting surface might be fairly regarded as "a most prolific source of danger."

In the language of the report which I have referred to, I am compelled to say that the committee that made it "is not the harmless thing we had imagined, but a most prolific source of misrepresentation." Let me bore you with a few figures from the Massachusetts Insurance Report referred to as to causes of fires. They are official returns from all the towns in the State, and cover the period of 1884 to 1889, inclusive.

Broken and exploded kerosene oil lamps and lanterns: Number of fires in 1884, 136; in 1889, 217; increase of 1889 over 1884, 59 per cent. Explosions of gas: Number of fires in 1884, 4; in 1889, 8; increase of 1889 over 1884, 100 per cent. Careless use of matches: Number of fires in 1884, 45; in 1889, 90; increase of 1889 over 1884, 100 per cent. Children playing with matches: Number of fires in 1884, 78; in 1889, 118; increase of 1889 over 1884, 49 per cent. Ignition of curtains and goods by gas and candles: Number of fires in 1884, 42; in 1889, 38; decrease in 1889 from 1884, 10 per cent., and this decrease is doubtless due to the fact that the incandescent lamp is rapidly replacing the gas jet and candles in windows and stores.

In 1884 "electric wires" caused 6 fires, and in 1889, 7; increase of 1889 over 1884, 18 per cent.

Total number of fires for the whole six years from each cause is as follows:

Broken and exploded lamps and lanterns, 947; explosions of gas, 18; ignition of curtains and goods by gas and candles, 253; careless use of matches, 447; children playing with matches, 473; electric wires, 42.

Besides these, during the same period, 25 fires came from gas and candles near woodwork, and 1884, 1885 and 1887, are not included, as they were not reported.

Lightning caused 208 fires; plumbers' pots, 27; thawing water pipes, 89; tramps, 54. There appear to be none charged to the much despised "tramp wire," unless he was the means of conducting the subtle fluid in some of the 42 cases against electric wires.

Cigar stubs in wooden spittoons caused 41 (1884 and 1885 not reported).

Smoking caused 233 fires, to say nothing of 3,024 marked as "unknown," many of which were doubtless due to this "most prolific cause," and yet "the management of the various systems" of smoking is not regarded as "the great problem" before the fire underwriter of to-day. He smokes day in and day out, perhaps causing his own share of fires, and yet he looks with increasing alarm upon a system of distributing light and power for the benefit of mankind, that has only been charged with causing 42 fires in Massachusetts in five years, as against 233 from smoking.

Let me step outside the confines of my little native State and give you a few comparative figures for the whole country, taken from the Chronicle Fire Tables for the year 1888. I have used 1888 instead of 1889, because I happened to have them more handy. I have selected a few classes of risks in which electric lights and wires are probably more generally used than in others.

In clothing stores the whole number of fires reported for the year is 1,072, 28 of which came from gas jets, 21 from lamps exploding, 9 from lamp accidents, 3 from gas explosions, 13 from matches—in all 74, as against 6 from electric lights and 9 from electric wires.

In the country and general merchandise stores, 4,847 fires are reported, of which 39 came from lamp explosions, 8 from lamp accidents, 3 from gas jets, 20 from matches—in all 70, as against 1 from electric wires.

In crockery and glassware stores, 179 fires are reported, of which 8 came from lamp explosions, 7 from lamp accidents, 3 from gas jets, 4 from matches—in all 22, as against 1 from electric wires.

In dry goods stores, 1,858 fires are reported, 123 of which came from gas jets, 34 from lamp explosions, 6 from lamp accidents, 7 from gas explosions, 19 from matches—in all 197, as against 10 from electric wires and 3 from electric lights.

In the fancy goods stores, 519 fires are reported, 26 of which came from lamp explosions, 7 from lamp accidents, 27 from gas jets, 9 from matches, 2 from candles—in all 78, as against 4 from electric wires.

In the United States, in 1888, the whole number of fires from the above named causes is reported as follows: Lamp and lantern explosions, 528; lamp and lantern accidents, 190; gas jets, 179; gas explosions, 63; matches, 592—in all 1,552, as against 49 from electric lights and wires.

There were 53 from stationary engines and boilers, and the number, though small, can be reduced just as fast as the electric motor takes the place of the boiler and stationary engine.

In the matter of insurance upon electric generating stations, the "great problem" is practically settled; and it has been settled by the establishment of an Electrical Mutual Insurance Company, organized for the prime purpose of improving and insuring such risks. There is no trouble whatever to-day in procuring ample insurance in the strongest of stock or mutual companies, provided the Electric Mutual carries a part of the risk; and I predict that within one year companies that have heretofore frowned upon an offer of insurance upon the best of such risks, or have charged excessive rates, will be competing for the business. The one truth contained in the extract of the National Board Report, namely, that the "business has come to stay," together with the fact that the owners of stations are willing to take their own risks by insuring in a company of their own, has inspired many of the underwriters with courage who were previously possessed with doubts and fears.

Of the 31 fires that were reported in electric light stations in 1888, 11 were from exposure to other risks, 4 were from unknown causes, 5 from causes not reported, 1 each from engine, furnace, spontaneous combustion, lightning and explosion, while 6 came from "electric wires," showing that after all it is not the mysterious electric current, nor the pranky wire that are responsible for the havoc, but that the ordinary causes that pertain to other risks, such as improper location contiguous to bad neighbors and carelessness of various kinds, are the chief sources of danger.

In seven years previous to and including 1888, 80 fires are reported in electric light stations—about 11 per year on the average.

On the whole I don't know what the relation between the interests is, from the underwriter's standpoint. What are his views to-day may not be to-morrow. There is no hazard that the underwriters, as a rule, have made so little effort to understand and consequently they are too largely guided by the caprice of popular prejudices and beliefs, neglecting to carefully study their tables of experience and be guided by the logic of events. There is also no hazard around which they have thrown so many restrictions. Those of us who know what peculiar and improbable conditions must exist in order for the "electric wires" to cause fire, can only look on and hope. Enlightenment comes slowly but surely, and the day is not far distant when the large majority of fire underwriters, forgetting their present ideas, will say: "I always maintained it was the safest kind of light and power." In the meantime, the present rapid development will go on regardless of the underwriter's standpoint. A few years ago his favor or opposition meant easy or slow progress for the electrical pioneer, because the first question asked was, "How will your wires and lights affect my insurance?" But the business has "come to stay" and that question is less frequently asked.

Magnetic Data of the Sprague Street Car Motor.

BY H. F. PARSHALL, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, MASS., MAY 21, 1890.

Figures giving the ratios of the lines of force through various parts of the magnetic circuit to the lines of force through the armature, have occasionally been fully published, the most noticeable being those given in a paper by Hopkinson some years ago. These ratios vary in the same type of dynamo or motor with any change of proportion; or, to put it in another way, in order that these ratios may remain constant in the same type, the ratios of the magnetizing force in the one part of the magnetic circuit to the magnetizing force in the other parts must also remain constant.

In making calculations on various motors made by the Sprague Company, I have found it necessary to confirm the assumed values of these ratios by measurements. It is the object of this paper to give the results of the measurements made on the street car motor, together with sufficient description, to make the values found of some use to those engaged in similar work. If I had had any intention of publishing these results, I would have endeavored to make them, in some ways, more complete than they now are, but so little detailed information exists on this subject, I have decided to give the result of my work up to date on this particular motor. The conditions under which this work has been carried on have not at all times been the most favorable for accuracy, but in the main, the results have been satisfactory.

Plate 1 shows the various peculiarities of the magnetic circuit, and gives dimensions of the several parts. The most noticeable points are:

The bell mouthing of the pole pieces

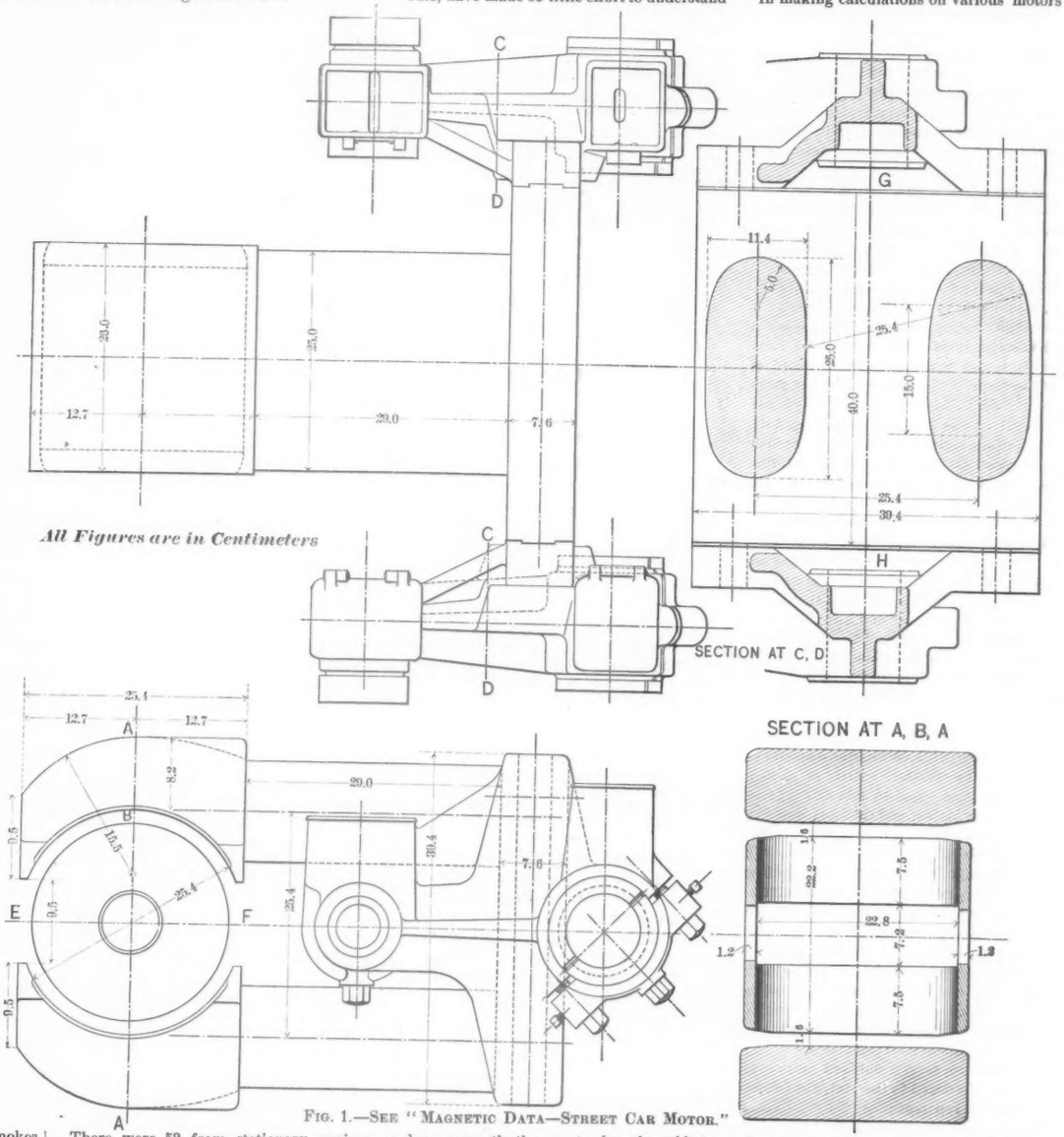
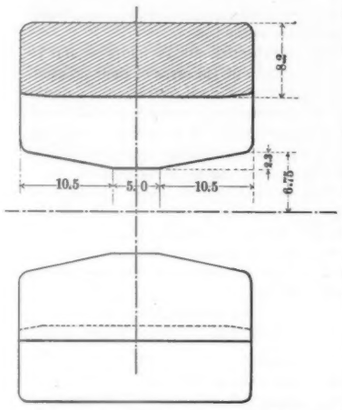


FIG. 1.—SEE "MAGNETIC DATA—STREET CAR MOTOR."

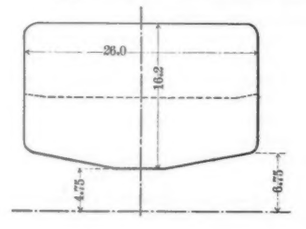
shown in the section "A B A." This bell mouthing greatly lessens the sparking, as does also cutting away of the tips of the pole pieces, as shown in "A B." With these modifications the brushes can be shifted an angle of 20 degrees without serious sparking.

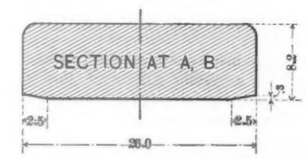
The other noticeable points are the cast-iron side brackets, the width of the yoke and its comparative thinness.

The method of getting the ratio of the lines of force in one part to the lines of force in another was the usual one. Coils of a few turns were wound around these parts, and connected to a ballistic galvanometer, and when the needle was standing at zero, a known magnetizing force was suddenly reversed.



The galvanometer used was an Edelmann with a heavy ring form of needle very slightly damped. The deflections being small, it was assumed that the first throw was proportional to the induction through





the measuring coil. The magnetizing coils were those commonly used on this motor.

Each coil was wound approximately to a depth of 4 centimeters, and along the cores 8.5 centimeters.

Coils were as follows:

First, nearest the pole piece, 28 turns per layer, 11 layers.

Second, 31 turns per layer, 11 layers.

Third, 31 turns per layer, 13 layers.

This gives 2,104 turns for both cores, or with a current of 6.75 amperes, which was used throughout, a magnetizing force of 14,200 ampere turns.

By noticing the curves in Fig. 2, it will be seen that this is the part of characteristic upon which the motor is most frequently worked. With different values of magnetizing force, different values of the ratio would be found. This becomes evident when we remember that the resistance of the gap remains constant, while the resistance of the iron increases with the magnetizing force. For this reason the curves of magnetization of the *different* parts of the magnetic circuit are not given.

The measuring coils were four turns of wire wound around the armature core at E. F, on the pole piece, at A. B. on the magnet core, midway between the ends and on the yoke G. H., had it been possible a coil would been wound around both the yoke and side brackets.

The following values were found:

$$\frac{\text{Lines through magnet}}{\text{Lines through armature}} = 1.45$$

$$\frac{\text{Lines through middle of yoke}}{\text{Lines through armature}} = 1.27$$

$$\frac{\text{Lines through middle pole piece}}{\text{Lines through armature}} = 0.666$$

Cast-iron pole pieces:

$$\frac{\text{Lines through magnet}}{\text{Lines through armature}} = 1.52$$

$$\frac{\text{Lines through middle of yoke}}{\text{Lines through armature}} = 1.33$$

$$\frac{\text{Lines through middle pole pieces}}{\text{Lines through armature}} = 0.7$$

The effect of the leakage from the side brackets is shown in Fig. 2, the upper curve being the characteristic with them removed, and the lower curve being the characteristic with brackets on. The dropping of the curve shows the magnet cores are sooner saturated with the brackets on. The difference is small. It would be somewhat greater did not the brackets reinforce the yoke. These curves were first obtained by separately exciting the fields and taking the number of revolutions, with a driving current of one ampere through the armature.

The lower curve has, by comparison, been found to be a close approximation to the characteristic when the armature is run with currents for which it was designed.

Fig. 3 shows the characteristics of two motors, one with the wrought-iron pole piece, and the other with the cast-iron pole piece, the gap being 2.85 instead of 3.2, the side brackets being one in each case. The difference between these two characteristics is somewhat striking, and carries its own lesson.

I wish here to acknowledge my indebtedness to Mr. G. J. Scott for the assistance he has given me in making measurements.

The plate shows two forms of pole piece; one has a full line. This is the cast-iron; the dotted line shows the wrought-iron pole piece.

Electricity and Adhesion.

Mr. Daft, who was first to assert the possible increase of adhesive power between the wheels and rails when an electric current was made to flow across the contact, has recently criticised Mr. Crosby's experiments, to which we referred in our last issue. While agreeing with Mr. Crosby that the effects are probably inappreciable with currents usually employed on electrical railways, Mr. Daft still maintains his view that with the heavier currents he was formerly in the habit of working with, the effect is a very powerful one. The unsatisfactory nature which we have already alluded to of experiments made on a stationary car whose wheels are made to skid on the rails, is pointed out by Mr. Daft, who considers that in consequence Mr. Crosby's investigation is not at all conclusive. The subject is of sufficient interest and importance to render further experiments desirable, and it is to be hoped that Mr. Daft will be able to follow the matter up.—*The Electrician, London.*

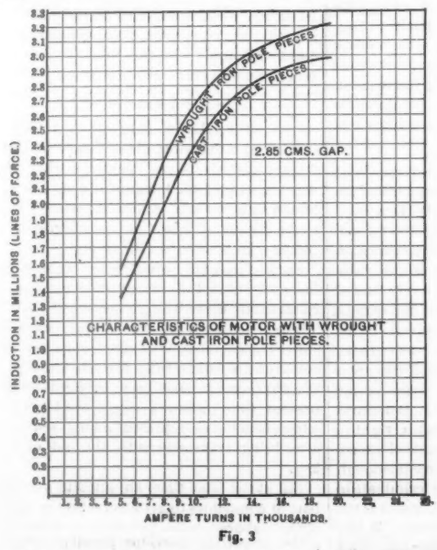

WROUGHT IRON POLE PIECES
CAST IRON POLE PIECES
2.85 CMS. GAP.
CHARACTERISTICS OF MOTOR WITH WROUGHT AND CAST IRON POLE PIECES.
INDUCTION IN MILLIONS (LINES OF FORCE.)
AMPERE TURNS IN THOUSANDS.

Fig. 3

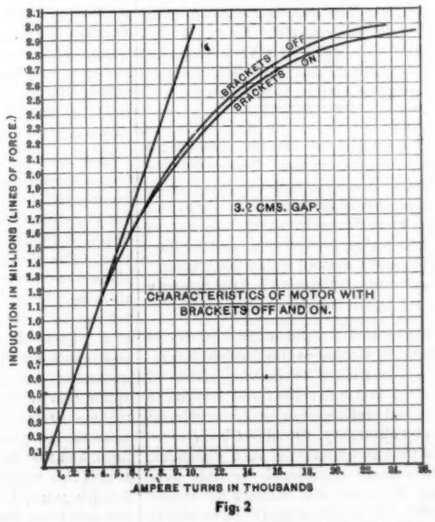

BRACKETS OFF
BRACKETS ON
3.2 CMS. GAP.
CHARACTERISTICS OF MOTOR WITH BRACKETS OFF AND ON.
INDUCTION IN MILLIONS (LINES OF FORCE.)
AMPERE TURNS IN THOUSANDS

Fig. 2

The Central Electric Company.

Mr. W. H. McKinlock, president of the Central Electric Company, of Chicago, was a recent visitor to New York.

In conversation with a REVIEW representative, Mr. McKinlock stated that the business of his company was increasing very rapidly. The "Okonite" wires were growing fast in popularity; in fact, Mr. McKinlock, while in the city, placed an order with the factory for 3,000,000 feet. Large shipments are constantly being received from New York to supply the demand.

The Central Electric Company is handsomely located at 116 and 118 Franklin street, Chicago, and has one of the best equipped and arranged electrical supply houses in the world. The establishment is planned with rare good judgment, so that the company is able to handle its large and growing business expeditiously.

The success of the Central Electric Company is a very pronounced one, and shows what brains and energy will accomplish in a short time in the rapidly extending field of electrical work.

Electric Power in Rutland.

The Rutland, Vt., Electric Light Company has closed a three years' contract with the Vermont School Seat Company, to furnish electric power for running the machinery in the new factory which the School Seat Company is erecting, the contract to take effect from July 1, 1890, or as soon thereafter as the buildings are completed. The motive force, at first, will be supplied through a 30 horse-power motor; but the style has not as yet been decided upon. The motor will be installed in the factory of the School Seat Company, the main pulley having connection, by shafting and counter-shafting, with the secondary pulleys of the different machines in operation; and the current will be carried by two special circuit wires of heavy insulation from the electric central station, the distance between the points of generation and distribution being nearly a mile. The details of the equipment cannot be arranged until the buildings are nearly completed. The light company estimates that the apparatus can be set up and placed in running order in about 10 days.

This new departure of the Rutland Electric Light Company will necessitate considerable addition to the machinery of its plant; and after July 1 the engines will be run day and night.

Red Lion, Pa.—The Red Lion Electric Light Company; capital, $1,200.

Dowagiac, Mich.—The Dowagiac Gas and Electric Company; capital, $15,000.

Stockton, Cal.—The Stockton Electric Construction Company. Directors: F. E. Birge, Thomas E. Curran, A. Humphrey, George A. Koch, J. J. Scoville.

Anderson, S. C.—Anderson Electric Light Company, with a capital stock of $10,000. The incorporators are, John T. Roddy, W. C. Whitner, J. S. Fowles and F. T. Wilhite.

Chicago, Ill.—Worrell Electric Construction Company, to construct and maintain electric plants; capital stock, $500,000; incorporators, C. E. Gaylord, M. J. Frost, C. Y. White.

Duluth, Minn.—The West Duluth Electric Company. The capital stock is $50,000, and the incorporators are, D. H. Merritt, O. H. Simonds, Jos. Sellwood, J. L. Cornwell and F. W. Merritt.

Chicago, Ill.—The Michigan Fuel Company, to manufacture and supply gas, electricity, etc.; capital stock, $2,000,000; incorporators, George B. Kidder, Thomas I. Porter and C. C. March.

Chicago, Ill.—The Chicago Arcade Rapid Transit Railway Company, capital, $8,000,000; incorporators and first board of directors, E. Louis Kuhns, H. A. Ritter, A. F. Shuman, Percy L. Shuman and Joseph H. Defrees, all of Chicago.

Portland, Me.—Beacon Vacuum Pump and Electrical Company; capital stock, $1,000,000; president, Jacob Heilborn; treasurer, L. E. Whicher; business to be prosecuted, general electrical business and dealing in vacuum pumps.

Sacramento, Cal.—The Sacramento Electric Construction Company, for general electrical business, with the following directors: W. Gambs, N. B. Lazard, G. W. Daywalt, W. R. Lett and W. B. Reynolds. Capital stock, $1,000,000.

Butte, Mont.—Silver Bow Electric Railway. The capital stock is $200,000, the term of incorporation is 20 years and the incorporators are, J. H. Lawrence, J. W. Fairfield, Paul Davis, J. H. McMonagle, O. Hight and J. D. Thomas. The first four named are the trustees.

Los Angeles, Cal.—The Rhodes & Keese Electric and Supply Company; capital, $25,000. The directors are, S. J. Keese and G. F. Kernaghan, of Pasadena, and T. H. Rhodes, W. I. Keese, G. Wiley Wells, J. F. Cosby, E. F. Spence, B. W. Lee and Frank Sabichi, of Los Angeles.

St. Louis, Mo.—East St. Louis Electric Railroad Company. The capital stock is $150,000, with Henry F. Bader, Paul W. Abt, Edmund Wallace, Fred Leber, C. T. Jones, Daniel Sullivan and H. D. Sexton, as commissioners. The company will immediately commence building the road.

Tarentum, Pa.—Tarentum Traction Passenger Railway Company, capital $50,000. The directors are, John C. Grier, of Punxsutawney; David O. Hutchinson, of Pittsburgh; Worthy A. Dumbrill, of Allegheny City; Samuel Lauck, of Driftwood; Charles E. Schoop, of Franklin, and John M. Morrison, of Logan's Ferry.

Chicago, Ill.—Calumet Electric Street Railway Company, organized to construct a railway from a point in Chicago to the boundary line between Illinois and Indiana; capital stock, $50,000; incorporators and first board of directors, Nathaniel K. Fairbank, Joel D. Harvey, William V. Jacobs, Otho S. Garther and Samuel E. Gross, all of Chicago.

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The annual meeting of the Institute of Electrical Engineers was held last week. The visit to Boston was a pleasant and profitable one. A number of the interesting papers read before the Boston meeting are presented in this issue.

The trustees of the American Society of Mechanical Engineers now have in their possession the title deeds for the house and lot at 12 West Thirty-first street, this city. This will be their home. The house is to be renovated and electric lights introduced.

The New York Electrical Society is now independent of the American Institute, and fills a position of its own, in distinction from the Electric Club and the Electrical Engineers, of this city. New York has now three well-known electrical organizations, each possessing a strong individuality.

It's really wonderful the way capitalists are taking hold of the electric railroad for strictly booming purposes. The statistician will soon be preparing tables showing us the ratio of improvement in property reached by electric roads, considering the elements of time, past value, present value and the like. And the beauty of it all is that the "boom" is always a substantial one when the property is reached by the popular electric road.

Owing to question put to the ministry in the House of Commons, the British government has instructed its consular agents in the United States to collect and forward to London all information as to accidental deaths by electricity, the object being to ascertain the exact number of such casualties, of which many sensational accounts have reached the other side through newspaper agencies. As in this country, these highly flavored newspaper stories have been largely made use of in England to prejudice the public against the electric light, and the industry has suffered accordingly.

An electric railway was recently inaugurated at Buda Pesth, and the success of the venture has been marred by a most unfortunate accident which occurred a short time ago, and has done much to render the road unpopular with the public. It appears that a woman attempted to cross the track in front of one of the cars, and the driver not being able to stop in time, she was run over and horribly mutilated. The crowd that witnessed the accident, with the usual impulsiveness of crowds, became infuriated with the unlucky motorneer, and he was secured from violent treatment only by the exertions of several mounted policemen.

In a certain window, in a side street off Broadway, where electrical establishments most do congregate, may be seen an arrangement consisting of a plant in an ordinary flower-pot, a bunch of flowers in a battery jar, and a large glass accumulator cell containing a quantity of amber colored liquid, in which are immersed various battery plates, from two of which wires are led to the plant and the bunch of flowers. This peculiar arrangement of electrical and horticultural objects is labelled "The Electrical Plant," and arouses much interest in the enquiring minds of observant passers by on the sidewalk. Needless to say, the combination is a little sell on the public, gotten up by the light-hearted denizens of the establishment in question.

Rumors of an immense electrical combination or "trust" have been very prevalent of late. The fluctuations in electric stocks have furnished the net-work upon which the daily papers of this and other cities have constructed articles of sensational character. Anything at all new in the electrical field concerning the Thomson-Houston and the Edison companies, has been twisted around to serve the purposes of the writers of these vivid articles.

A prominent official of the Edison General Electric Company, in an interview with a representative of the REVIEW, said, "The officers of this company are not aware that any such combination is, at present, in process of formation. Furthermore, they have no knowledge that there is any prospect in the future of a combination of the Edison and Thomson Houston interests."

A special despatch from Pittsburgh says: "George Westinghouse, Jr., and George M. Pullman, it is now known, have decided to form a new electric railway company, to be known as the Pullman-Westinghouse Electric Street Railway Construction Company, whose main office will be in Pittsburgh or Chicago. Some ten days ago, Mr. Pullman came to Pittsburgh and inspected Mr. Westinghouse's new motor and the air brake. Plans of the new car were submitted to Mr. Westinghouse and both gentlemen went to New York, where they formed a big stock company." This is a particularly strong combination for progressive electric railway work. If the union has been made as above stated, a great impetus will be given work in this rapidly growing branch of the electrical field. It would seem that the car horse is doomed.

Kemmler's case before the Supreme Court was eloquently and forcibly presented, with great legal ability and ingenuity, in a carefully prepared argument, which bore evidence of electrical knowledge in its composition. The Chief Justice and all his associates were on the bench, and every one of them manifested most attentive and earnest interest in every question involved in the case. Their decision, which was written and announced by Chief Justice Fuller, was unanimous. It denied every point in the application for the writ of error. It declares that the State of New York has a right to make the law providing for electrical executions, and that the statute is constitutional. It says this method of putting criminals to death is unusual, but not cruel, which is the one point on which the Justices, in the nature of things, are not informed. This opinion will, undoubtedly, have great influence in shaping future action in matters pertaining to the subject.

ONE WAY TO BUILD LIGHTNING RODS.

An instructive little story reaches us from Louvain, Belgium. It appears that after considerable deliberation the municipal council of that town made their choice of the system of lightning conductors to be adopted from among the number that had been presented to their notice, and the work of protecting the town hall was in progress at the commencement of April last. It seems, however, that those in charge of the operations did not bear in mind that lightning gives no forewarning as to where it is going to strike, and they had found it more convenient to install the conductor first, leaving the ground connection to the last.

The unexpected always happens, and to convince them of the error of their proceedings, a lightning flash, attracted no doubt by the incomplete preparations which had been made to rob it of its powers, struck the building, causing serious damage and occasioning a panic among the occupants.

This interesting little anecdote contains a moral of special interest to those engaged in the installation of lightning conductors, and points out the necessity of proceeding with method and prudence, *not* putting the cart before the horse.

COLORED INSULATORS.

The Belgian Government has recently tried, with considerable success, an experiment calculated to circumvent the malevolence of stone-throwing vagrants who were causing the telegraph department great expense for the replacement of broken insulators on telephone and telegraph lines, which, following the highways for long distances, continually suffer in this respect.

At first iron-clad insulators were tried, but another solution had to be looked for as they were too heavy and too expensive, and the expedient of substituting the large white insulators by colored ones of the same dimensions was resorted to. Numerous experiments were made and, finally, an insulator of a grayish brown tint, similar to the color of the poles, was obtained. The coloring was effected by a coating or enamel of silicate over the ordinary insulator, thus the insulating properties were in no way impaired.

The colored insulators have been a marked success. In a certain section of line it was found that during one year 25 per cent. of the white insulators had to be replaced, as against 13 per cent. of the colored, the advantage of the latter having been apparent from the first days. Even allowing for the slightly higher cost of the colored insulators it has been established that they effect an economy of 42 per cent. in the expense of replacing breakages in cost of material alone, without counting the economy in labor from having fewer repairs to make. In future, when a white insulator is broken it will be replaced by a colored one, and if this meets with the same fate, an impregnable iron-clad insulator will be substituted.

CABLE RATES.

It appears that after all the Telegraph Conference at Paris is not about to alter the word limit for code telegrams from ten letters to eight, as was at first reported, much to the dismay of those of the telegraphing public who believed in the rumor.

Such a change would have caused an immense amount of inconvenience to merchants and others using established codes. There is no doubt that the cable companies suffer considerable loss of revenue on account of the wonderfully fine pitch to which telegraph codes have been brought at the present time, when a single word of ten letters is made to represent a long sentence after being translated with the aid of the key.

But at the same time, an attempt on the part of companies to get level with the users of the elaborate codes to which we refer, by means of cutting down the limit of letters allowable in a word, would be a highly vexatious and unpopular proceeding, and there can be no doubt that the companies are acting wisely in abandoning the idea.

CORRESPONDENCE.

Electrical Happenings in Chicago, Boston and Washington.

OUR CHICAGO LETTER.

The Illinois Electric Material Company was incorporated last week under the laws of this State, with a capital stock of $25,000. The object of the company is to carry a stock of line supplies, both for electric light and street railway plants. The incorporators and officers are as follows; H. S. Winston, president and treasurer; Ernest Hoefer, vice-president and manager; Ernest L. Clark, secretary. Mr. Hoefer is well known to the electrical fraternity throughout the West, and for the past year has held the agency of Bishop white core insulated wire and Trinidad moisture proof line wire, the agencies of which will be retained by this company. Mr. Clark, as the western agent of the Walworth Manufacturing Company, is also well known in the West. The new company will occupy offices in the Rookery Building, and are preparing to stock their storehouses with a full line of supply goods.

Electric Street Railroad for Lansing.—Lansing, the capital of Michigan, is to have a model electric street railway built by the Westinghouse Electric Railway Company. The Westinghouse people have a national reputation for their ability in perfecting everything that they may undertake, and, in street railway work, they guarantee that every road will be a model to which prospective builders can confidently refer for perfection of system in every detail, with absolute surety that every part will be of the latest and most approved pattern known in electrical science. The road will be pushed to completion at once.

Personal.—Mr. George Westinghouse, Jr., was a recent visitor in this city.—C. H. Rusling, Western representative of the Thomson-Houston Electric Company, with headquarters in Kansas City, Mo., was a recent visitor in Chicago. Mr. Rusling has removed his offices from the National Bank Building to the New York Life Building, where he will be pleased to welcome his friends and customers.

Connellsville, Ill., will have an incandescent electric light plant. Contracts have not been let yet.

The Primary Battery Company, of Missouri, at East St. Louis, was incorporated last week with a capital stock of $500,000. Incorporators, Frank Stillwell, Wm. M. Steele and E. A. Cheeney.

The Dearborn Light and Power Company was recently incorporated with a capital stock of $25,000. Incorporators: A. L. Baker, S. T. Parks and E. F. Bunyan.

The Cicero Gas and Electric Light Company have increased their capital stock to $1,000,000.

W. H. McKinlock, president of the Central Electric Company, has just returned from a business trip through the Middle States. Among his sales was one single order for 1,000,000 feet of Okonite wire. This is a good proof of the popularity of Okonite, as well as evidence of the persuasive ability of Mr. McKinlock.

W. P. Adams & Company have closed a contract to furnish an 80 horse-power McIntosh & Seymour high speed engine for Phillipsburg, Montana. The engines will be used to drive a Westinghouse alternating arc machine 3,000 revolutions per minute; the fly wheel on the engine is to be 80 inches in diameter and will make 300 revolutions per minute. D. B. D.

Chicago, May 24, 1890.

OUR BOSTON LETTER.

Mr. H. A. Cleverly, of the Cleverly Electrical Works, Philadelphia, visited this city on Friday, and was properly entertained by many of his friends.

Messrs. H. D. Stanley and C. O. Baker, Jr., both inseparable and indefatiguable workers in the electrical vineyard, enjoyed the hospitalities of their Boston friends recently.

New Electric Motor.—Mr. Warren S. Hill, of this city, is constructing a new type of electric motor, which possesses novel features as well as fine points of efficiency. An illustrated article descriptive of the new motor will soon be forthcoming.

Mr. W. A. Carey, one of the special agents for the Thomson-Houston Electric Company, is now busily engaged enlarging and reorganizing several electric light stations in Western Massachusetts.

Electrical Engineers.—The Boston members of the American Institute of Electrical Engineers who attended the recent meeting are, Prof. C. R. Cross, John W. Duxbury, Thos. D. Lockwood, Prof. Elihu Thomson, Chas. Williams, Jr., W. H. Forbes, Edward Blake, E. W. Rice, Jr., A. L. Rohrer, C. J. Vanderpoele, Geo. F. Curtis, W. H. Blood, Geo. W. Mansfield, John Tregoning and Hermann Lemp.

Advertising by Electric Lights.—Mr. Fred. A. Swan, of this city, well known in electrical circles, informed me, recently, that he had succeeded in putting into practical service a novel advertising medium for use on streets at night. It consists of a canvas-covered wagon containing several storage batteries which furnish current to a number of incandescent lamps. Illumination is thus brilliantly afforded to show to excellent advantage the painted advertisements displayed on the canvas covering of the wagon.

An Electric Railway for Peabody, Mass.—The Essex Electric Railway Company will soon have its line in operation. It has already awarded a contract to the Bay State Company, of Peabody, to furnish power. Work is being vigorously pushed on the enterprise, and as the line is not a long one, it will be finished and the electric cars running within a month or six weeks.

Lynn Electric Railway.—The New Belt Line Electric Road, at Lynn, Mass., was tested early in the week and everything worked smoothly and satisfactorily. As the power station of the road is not completed, the power will be obtained from the Thomson-Houston factories by connecting the trolley wire of the road, which conveys machinery between the factories to that of the Belt Line at the corner of Federal street and Western avenue, and also connecting it with a 500-volt machine. The ground wire is also connected with that of the factory line to make the circuit complete.

The Holtzer-Cabot Electric Company, of this city, has just issued its new catalogue "B." The publication is 102 pages, including the cover, is profusely illustrated, and printed on heavy cream (embossed) paper. It is the desire of the company to place a copy of the catalogue in every electrical supply house in this country and Canada. Attention of each reader of the catalogue is especially invited to the important matter on page 89. The Holtzer-Cabot Electric Company is having a very satisfactory run on its various lines of electrical goods and electric light supplies. The company make a specialty of the popular Eddy Electric Motor for which it is the New England agent.

The John Becker Manufacturing Company, No. 157 Pearl street, this city, has recently put in $1,500 worth of new tools and machinery, made necessary by the increasing business of the company's specialties. The electrical department is rapidly launching out, and the excellence of the work done is bringing in many orders from outside districts. Another order for $1,500 worth of additional tools has just been given, and these will soon be added to the equipment. This company devotes attention to the manufacture of electrical machinery.

The New England Electric Company reports having closed a contract with the Manet Street Railway Company, of Quincy, Mass., for equipping the cars of the latter with the Sprague System. The former has also made recent sales of Sprague electric motors (stationary) as follows: 15 horse-power motor to A. & J. M. Anderson and 10 horse-power motor to Mowry & Phillips, all of this city.

The Evans Friction Cone Company is doing a very large and satisfactory business among the electric light stations, particularly in the New England States, where the peculiar merits of its system is best known. The company has just furnished the new station of the Waltham Electric Light Company with eight friction cones; not a belt of any kind to be hereafter used by the company last named in driving its dynamos. The Evans Company has also recently placed four friction cones in the isolated plant of the Waltham Watch Company.

The Johnston Electric Train Signal Company.—The statement going the rounds to the effect that the above-named company had purchased the old Sun Electric Company's factory at Woburn, Mass., and intended to locate its plant there, is probably founded on the fact that the Signal Company has been approached by the citizens of Woburn, and special inducements offered by the latter, if the former would locate in that city, but the company has not accepted the proposition as yet, or had not up to the date of this writing.

Graphophone Works.—Advices from Hartford, Conn., under date of May 22d, state as follows: "The graphophone works at Colt's factory are now entirely shut down. This is due to the recent purchase by the Edison Phonograph Company. The machinery is being taken out and will be divided up among the different factories of the Edison Phonograph Works. Of the 70 men who were employed, some have found situations at Colts, others at Pratt & Whitney's, the Hartford Machine Screw Company, and other places. Joseph Daniels, who was the superintendent of the Graphophone Company, is now superintendent of Edison's Phonograph Works, at Orange, N. J."

N. E. Wiring and Construction Company.—Messrs. Sidney B. Paine and A. R. Bush, of the above-named company, visited New York City, recently, for the purpose of thoroughly investigating the system of tubing which has been so successfully placed in the market by the Interior Electrical Conduit Company. As is already a well-known fact, the company first named has been awarded the contract for wiring the New Exchange Building, on State street, this city; and doubtless it is the intention of Messrs. Paine and Bush to adopt the tubing system of the New York company, providing the result of their investigations proves satisfactory.

Mechanic's Exhibition.—The next triennial exhibition of the Massachusetts Charitable Mechanic Association—its 17th—occurs in October and November, and bids fair to be one of great value both to the industries of the country and to the people. Manufacturers of electric light and power machinery, and makers of electrical instruments, devices and apparatus of various kinds, will act wisely by making early application for space at the coming exhibition.

The Bangor Electric Light Company's new station at Veazie, Maine, will be, when furnished, one the largest of its kind in New England. The foundations are at present nearly completed and consist of more than 2,000 cubic yards of masonry. The entire length of the building will be 242 feet and the width 75. Six large water wheels are to be put in at once, each of 100 horse-power. In addition there will be an auxiliary steam power. Half a million feet of lumber will be used in the construction of the building.

Prospective Electric Railway.—Mr. A. F. Gerald and several other capitalists of Fairfield, Me., are interested in the projected electric railway to be built at Gardiner, Me., during the present year. It is proposed to run the road to South Gardiner, a distance of four miles, and to New Mills and several other places within a radius of two miles from Gardiner.

Electric Stocks.—Boston quotations at closing hour of the Exchange, Saturday, May 24, were as follows:

Thomson-Houston Electric Company	63½
" " " " Preferred.	26½
" " " " Series C..	17.
" " " " Series D .	8.
Thomson Electric Welding Co	225.
" European Welding Co	117.
Westinghouse Electric Co	41.
Fort Wayne Electric Co	13½
Lynn Gas and Electric Co	150.
Edison Phonograph Doll Co	4¼
TELEPHONE:	
American Bell	235.
Erie	43.
New England	52.
Mexican	1.30
Tropical American	1.25
National Tel. Mfg. Co. (acoustic)	.65

Boston, May 24, 1890. W. I. B.

OUR WASHINGTON LETTER.

The Answer of the Commissioner of Patents in the *mandamus* suit brought by the United States Electric Light Company to compel the production of a copy of a pending application, filed by Edison, asserts that he has not the power or right to impart information as to applications for patents pending before the office, inasmuch as Rule 15 forbids such action. The rule referred to is as follows: "Caveats and pending applications are preserved in secrecy. No information will be given, without authority, respecting the filing by any particular person of a caveat or an application for a patent or for the re-issue of a patent, the pendency of any particular case before the office, or the subject-matter of any particular application, unless it shall be necessary to the proper conduct of business before the office." The Commissioner claims that this rule is consistent with the law and entirely reasonable, and that any other interpretation of it would practically destroy all attempts to an impartial and fair examination of an inventor's application, which the statute calls for. Rule 15 has been in existence for 39 years, and in 1883, it was decided by the Secretary of the Interior that "the rule is such a one as the statute authorizes the Department to make, and for that reason has the force and effect of law. It is founded upon just ideas of propriety and has for its object the protection of applicants for patents. It prevents undue extension of jurisdiction by the office and the intervention of persons who have no interest, in the legal significance of the word, in the questions submitted for determination." As heretofore stated in the REVIEW, the United States Company, in appealing to the court to compel the Commissioner to furnish it with a copy of a pending application, took the ground that no papers in the office, except caveats, could be held secret.

Dr. Green, the president of the Western Union Telegraph Company, on the 20th, went to Washington, by invitation of the House Postal Committee, to make further explanations relating to the government telegraph subject, but only four members of the committee appeared to keep the appointment and the hearing was postponed. Dr. Green expressed his readiness to come before the committee at any time and to furnish any information desired.

The Treasury Department is preparing to commence an electric lighting installation in the new court house and post office at Pittsburgh, Pa. The basement and first stories of the building is to be wired for 650 incandescent lamps, and proposals for this work will be received until June 17th.

Washington, D. C., May 24. G. C. M.

PERSONAL.

Capt. W. L. Candee, treasurer of the Electric Club, made the best score at Creedmoor shooting tournament last week.

Mr. Durant Cheever, secretary, and F. Cazenove Jones, superintendent of the Okonite Company, left last week on a business trip to London, England.

Col. Gardiner C. Sims, of Providence, has been appointed World's Fair Commissioner for the State of Rhode Island. No better man for the place could have been chosen.

Mr. S. C. Peck, of Boston, was a welcome New York visitor last week. Mr. Peck has been an invalid for several months past, but recently returned from the Bermudas completely restored to health.

H. A. Cleverly, the ever-awake Philadelphia representative of the Perret motor, spent Wednesday of last week looking over New York City, and enjoyed the inspiration that visitors to the metropolis always find here.

Mr. E. R. Knowles, a well known electrical and mechanical engineer, of Brooklyn, has opened an office at 181 Broadway, New York City. Mr. Knowles is associated with Mr. Ernest C. Webb, and will transact a general engineering and expert business.

Mr. D. I. Carson, General Superintendent of the Southern Bell Telephone Company, has returned from a visit to the exchanges of his company, and reports the Southern territory improving continually in business, and, consequently, the demand for telephones is ever increasing.

Mr. D. W. Baker, senior member of the firm of Baker & Company, platinum refiners, Newark, N. J., sails for Antwerp on the "Friesland," May 28th. Mr. Baker will be accompanied by his wife, and will be absent nearly four months and will make an extended tour through Russia.

The Cable Word Limit.

The cable regulations now in force provide that every word exceeding ten letters in length, shall be charged for as two words when transmitted by cable. Rumor has been widely prevalent of late to the effect that the International Telegraph Conference, now in session at Paris, intended to reduce the word limit from ten letters to eight. No proposition of this sort, however, has been submitted to the Conference. Officials of the cable companies in London declare that they have never thought of proposing such a change, which would cause endless trouble and result in no equivalent good.

The Commercial Union Telegraph Company has completed its new line of wires from Boston to Newburyport and Amesbury, Mass.

Where *is* the dog? In arguing against the practicability of electrocution, before the Supreme Court, at Washington, Kemmler's attorney stated that Harold Brown had experimented on one dog which the highest electric power to be obtained could not kill.

The Yaquina Telephone Company have sent word to the business men of Florence, Ore., offering to put their line through to Florence for a very reasonable subscription to help put up the line, giving to all those who subscribe, tickets of credit for the full amount of their subscription, entitling them to send messages at the regular rates for all their subscription.

Every telephone in New York is tested once every day. Not everybody knows this fact. But you will find it out if you have a 'phone put in your house. The testing hours are in the morning, and if you have been out late at night the bell is sure to ring about 7 or 8 o'clock, and when you go post haste to the receiver, this conversation ensues:

"Hello, Central."

"Hello, 999. Is your telephone all right?"

"Yes."

"Ring the bell, please. All right; thank you. Good morning."

And you go back to bed wishing the operator at Central was a man and bodily present so you could kick him.

Telephonic News

*** The Gilliland Electric Company's works at Adrian, Mich., are going to run 13 hours a day manufacturing nickel-in-the-slot phonographs so as to get out 500 machines for a New York house as soon as possible. They will make about 10 a day.

*** The telephone service between Islip and New York city has not satisfied interested parties, and the New York and New Jersey Telephone Company, desiring to give better accommodations, has offered to put in a new metallic circuit and proper connections and give satisfactory service at all times if 20 subscribers at $150 per year can be obtained at Islip and Bay Shore. A number of gentlemen, among whom are W. Bayard Cutting and R. C. Livingston, have agreed to this proposal.

*** At a meeting of the Aqueduct Board last week a resolution providing for the construction of a telephone line to connect the several stations along the line of the new aqueduct was adopted. The Metropolitan Telephone and Telegraph Company offer to construct the line and maintain it for five years for $5,500 a year. But Engineer Fteley learned that, in co-operation with Public Works Commissioner Gilroy, the line, a double metallic line, using long distance instruments at the One hundred and Thirty-fifth street gatehouse, Shaft 25, South Yonkers, Ardsley, Pocantico and Croton Dam, could be built for about $5,000, and it was decided to build.

Underground Telephone Wires in Boston.

The annual report of the New England Telephone and Telegraph Company gives figures showing the work done in placing telephone wires underground in Boston during 1889.

Work was done upon 11 different routes. The total length of conduit constructed in 1889 was 27,978 feet, containing 239,334 feet of duct. The underground system in Boston now consists of 73,752 feet of conduit, the total length of duct being 733,749 feet, or about 139 miles, with a capacity for about 16,000 miles of single conductor.

During the year cables have been drawn into the ducts as follows: 418 feet of 200 conductor cable, 3,876 feet of 130 conductor; 103,608 feet of 120 conductor; 2,623 feet of 100 conductor; and 1,440 feet of 50 conductor. In the use of the conduit system, the Boston exchange now stands second among all the exchanges in the country, New York being the only city in which a greater mileage of underground wire is in operation for telephonic purposes.

Dangers to Firemen.

Mr. Allen R. Foote, of Washington, recently read an interesting paper before the North Carolina State Firemen's Association, at Charlotte, N. C., on "The Dangers to Firemen from Electric Light Wires in Buildings." Long handled insulated shears were recommended as the only safe way to cut live wires. It was a question whether, instead of cutting the wires and thus extinguishing the lights in a building which was on fire, it were not better to allow the lights to assist the firemen in their work.

Death of John W. Roloson.

John W. Roloson, the well-known telegraph operator, died in Brooklyn, Thursday of last week, from injuries received while riding a bicycle. He was run into by a wagon, thrown off his wheel, and the injuries about the head that he received resulted fatally.

Mr. Roloson was night manager of the Postal Telegraph Company, 187 Broadway, and was one of the most expert and widely known telegraph operators in the country, winning the second prize in Class A, at the recent National Telegraphing Tournament in this city.

Electricity in the Navy.

BY GILBERT WILKES, U. S. NAVY.—READ BEFORE THE ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MAY 20, 1890.

I have taken as my title "Electricity in the Navy," and shall give in my paper the general conclusions derived from five years' more or less intimate connection with the application of electricity in our naval service.

The electrical engineer has little to do with the placing of the dynamo room, which is of necessity governed by the arrangement of the ship as a fighting machine. I shall, therefore, merely consider the power and apparatus of the plant, commencing with the engines.

Both in this country and abroad, compound condensing engines have been used, some having separate condensers, some exhausting into the main condensers of the ship, but the preference seems to be in favor of simple double acting, high speed engines, the reason being that the power used for electrical purposes is so small in proportion to that of the main engines of the ship (only about an average of one per cent.), that the saving does not pay for the additional complication and cost. However, with a given plant, the engine should be constructed to allow little variation of speed under large changes of steam pressure, in order to take advantage of the main condenser when possible.

In our service both horizontal and vertical engines are now in use, the preference in some cases being the result of the shape of the available space. No data has yet been obtained as to the most economical type, but both are doing good service, the mishaps having been due to accidents. Of late years all of the engines put in for electric lighting have been high speed, the largest of about 25 horse-power and running at 400 revolutions.

The important points in the consideration of a marine dynamo are:

1st. It should be direct driven. The reasons are obvious, as not only is the space taken up by the belting valuable, but in a seaway the danger of running belts must be considered, especially when it is taken into account that naval vessels are fighting machines and the possibility of accidents must be reduced to a minimum.

2d. It should be compact. This is a natural extension of the above. Even now it is difficult to find room for all of the machinery, stores and ammunition, besides providing room for berthing the crew on a modern man-of-war.

3d. It should be free from liability to injury by salt water, and not too subject to mechanical damage.

In this respect there remains room for considerable improvement, the late dynamos now better filling this requirement than did the old "L" machine on the Trenton, in 1883, the first dynamo afloat in our navy, and which ended its useful career in the great storm at Samoa, last year, when it ran until the water had put out the fires under the boilers.

On board ship salt water and damp air get everywhere, and within the last year a number of cases of slight burn-out have occurred in armatures which, when installed, measured high in the hundreds of thousands of ohms insulation. The dynamo should not be easily harmed. The dynamo room is now always low down in the ship, under the protective deck (if there is one), and when the light is not in use the room is very dark, rendering careful inspection difficult.

4th. The dynamo should have small effect upon the compasses. This point has received little attention, though it is a matter of great importance, as the effect on many vessels is so large that, in order to work up the day's run, it is necessary to know the hours during which the dynamos have been in operation. Complete deviation tables are, therefore, necessary for the two cases. In different types of dynamos the effect with a 20 horse-power machine, at a distance of 12 feet, will vary from less than one-twentieth of the horizontal component of the earth's magnetism, to several times the strength of the horizontal component. The latter is, unfortunately, rather the rule than the exception and, in consequence, the position of the dynamo room has to be well borne in mind in locating the standard compass.

5th. It should be easy in running and require but little attention. The machine should be non-sparking under constant load and also be able to stand sudden large changes of load with little sparking. This is necessitated by the fact that the dynamos now supplied for incandescent lighting are also used for search light work and the conditions are aggravated by most of the search lights having hand regulation only. Thus, with a 200 ampere machine, not only are from 50 to 100 amperes thrown suddenly on and off, but, at the moment that the operator at the projector brings the carbons together, the dynamo is suddenly called upon to deliver over three-fourths of its total capacity.

6th. It should be efficient and run cool, the former in order to avoid the waste of energy and a corresponding amount of the coal supply and also in order to avoid over heating. The dynamo rooms on ship-board are, at best, warm, notwithstanding the motor fans, which are now usually supplied, and thus the safe limit of extra heating is reduced. At the same time consideration for the attendants requires that the cramped space be kept as cool as possible.

7th. The dynamo should maintain a constant potential at all loads. This is, of course, accomplished by compounding, and, as there is only about three per cent. drop, it is usual to compound exactly or to only over compound enough to allow for the decrease in the engine's speed with load.

8th. The dynamo should be light. The reasons are obvious, but it is considered last, because usually a careful study of the materials and arrangement of the plant can accomplish more towards reducing the total weight than the strict adherence to a specification of watts per pound of dynamo. Thus, consider the difference between the weights of a 40 horse-power ship plant on a five watts per pound specification, and upon a four watts specification. Two 200 ampere, 80 volt dynamos, with their share of the bed plates, will only weigh about 7,500 pounds. Twenty per cent. of this will be 1,500 pounds, an amount a large portion of which can really be saved in some cases by more careful attention to the amount of wire and moulding employed.

Naturally no one dynamo can best fill all of these conditions, and while the order in which they are above arranged will usually approximate to their relative importance, special cases arise which demand a rearrangement. Thus, on torpedo boats, the most important quality is small size. With this in view, numerous devices have been placed upon the market and faithfully tried, but none have, to my knowledge, proved satisfactory. The requirements of high efficiency, low speed and low heating, all give way in this class of dynamo to the necessity of compactness and light weight. Good results were hoped for from the Parsons turbo-electric generator, but experience at Newport demonstrated that the turbine was so inefficient in its consumption of steam as to place its use out of the question. There is as yet no apparatus to satisfactorily fill this want.

Up to the present all of our ship plants contain two or more similar sets, each composed of an engine and one direct driven dynamo. The larger of these are of 200 amperes capacity; a very convenient unit, but one which can be doubled in capacity with advantage in ships which are light below decks and which are likely to soon have extensive motor applications; for example, vessels of the monitor type.

The voltage in use in the navy is 80 volts, this having been fixed upon as a mean between the most efficient pressure for the incandescent system and the voltage necessary for the search lights, to which current is supplied by the regular service machines. The incandescent lamps have given excellent results as to life from the very start, owing in great measure to the fact that low efficiency lamps are always used, nothing more economical than four watts per candle-power being usually required.

Search lights of 50 volts and from 50 amperes up are used, two or more being supplied, according to the size of the ship. Some of these are imported, others are made in this country.

The two-wire system has always been used in the naval service, the ship never being allowed to form the return circuit. On account of the present beginning of motor work on board ship and the future developments confidently looked for, the direct current has always been used. Motors have thus far been used only in driving small fans up to one-half horse-power, for hoists, and, in one case, a motor has been used for training one of the large guns on the "Chicago." There are numerous small engines about a man-of-war varying from one to 50 horse-power. Some of the smaller ones might even now be replaced with advantage by electric motors, but it must be proved in each case that the motor not only does the duty as well as the engine it replaces, but also that it and any increase necessary in the generating plant take up less room and weigh less than the engine and its piping. This, of course, will always be the case where very small engines are replaced, and, as the tendency is to increase the capacity of the dynamo plant, it may not be long before motors may look for a larger field on board ship.

All circuits are water-tight, from dynamo to point of distribution, the cut-outs having stuffing boxes through which the lead covered wires enter. Even the switches and attachment plugs for portables are required, in certain places, to be water-tight.

One electrical application that presents many advantages on board a man-of-war, especially when on a foreign station, is electrical welding. However, when it is introduced on ship-board, the pressure of the generator should be reduced to 80 volts, in order that in case of emergency it might be used for lighting purposes, while the welders should have several sets of adjustable clamps. Welding machines have not yet been actually used on ship-board, but it is to be hoped that their introduction is a development of the near future. They cannot supplant any of the existing dynamos, owing to the necessity of motors, but must come in to occupy a place of their own, to almost entirely supplant the ship's forge and add to the general useful equipment.

Thus the man-of-war is the proper field for nearly every form of application of electricity, and when the storage battery becomes more suited to the service there required, there is no doubt that it too will come in for its proper share of usefulness.

As to the naval work on shore, in the electrical field little need be said, as the practice at naval stations must be similar to that in ordinary commercial work. However, a navy yard is an ideal place for the erection of a central station for light and power. The streets must be lighted; closely grouped about the station are offices and large shops needing light in the dark afternoons and power for motor work; then in an outer approximate semi-circle lie the officers' quarters; finally, there are anchor chains to be welded, boiler tubes to be repaired and numerous other similar operations which can be better accomplished by the welder than by any other known means. This in an ideal plant will call for arc lights, incandescent lights, constant potential motors, a welding generator and welders. The complete combination will probably not be realized at any one place within several years, but a good beginning has been made in the arc light plant recently installed for outside and shop lighting at the Washington Navy Yard, and the progressive plan adopted by the department leads us to hope that the shore stations will rapidly receive the benefits already enjoyed on ship-board. Owing to the usually close grouping of the buildings and to the demands for motors, it is probable that in only exceptional cases will the alternating current be used extensively. Good use is already being made of small motors for drilling purposes at the New York Navy Yard, where several are in constant operation, having driven out the portable steam engine, countershafting and belting.

The applications of electricity in the navy have always been on the increase, and any one who has served one cruise with oil lamps and one with electric lights and motors, will understand the favor in which the increasing use of electricity is held by the naval men.

Notes on a New Photometer.

BY PROF. EDWARD L. NICHOLS, BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, MAY 21, 1890.

Methods of photometry which take no cognizance of differences of quality are so ill adapted to the study of sources of light which differ from each other widely in temperature, that the introduction of some instrument by means of which both the character and intensity of an illuminant can be readily determined, would be a desirable adjunct to the equipment of our photometer rooms.

The instrument which it is my purpose to describe has been designed to meet this need. Existing types of the spectrophotometer may be made to give good results, but they are expensive instruments and so difficult to use that it is only in the hands of observers of considerable experience that accuracy is assured.

The new apparatus, the "horizontal slit" photometer, is, in point of fact, a spectrophotometer in which the polarizing device is entirely done away with. In it the extremely simple principle of the Bunsen photometer is applied successively to the various regions of the visible spectra of the source of light which are to be compared. A direct vision spectroscope of Browning's form is attached to the usual car of a Bunsen photometer, from which the disk and mirrors have been removed. The optical axis of the collimator is horizontal and at right angles to the photometer bar. The slit is horizontal and lies in a straight line joining the sources of light, which are set up in the usual manner at the ends of the bar. The bar itself is preferably of considerable length—in the case of the one upon which the original instrument under consideration was mounted, it was 500 c. m. long—and should be divided into 1,000 equal parts.

In front of the spectroscope slit are placed two right-angled prisms of the same size and made of the same glass (see Fig. 1). Their vertical adjacent edges bisect the slit, and light traveling from either end of the photometer bar is totally reflected by them, and enters the right or left end of the slit in

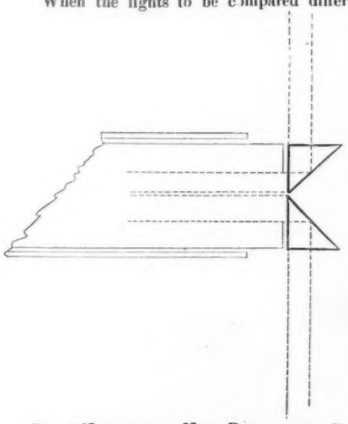
a direction parallel to the optical axis of the collimator tube.

The two sets of rays thus gathered into the spectroscope from the lights at the end of the bar are vertically dispersed by the Amici prisms, and appear in the field of view as two vertical spectra standing side by side. Equal wave lengths are in the same horizontal line, and any desired region may be brought into the center of the field by an angular movement of the ocular telescope. The telescope moves along the arc of a suitably divided semi-circle, to which it may be clamped by means of a set screw. Wave lengths, corresponding to the various circle settings, are determined once for all by observation of the more prominent of the Fraunhofer lines.

When the instrument, thus mounted, is placed at the middle of the photometer bar between lamps which are identical in intensity and quality, the two spectra are of equal brightness throughout, wave length for wave length, from red to violet. If the two lamps differ in intensity but not in quality, the two spectra will differ in brightness by the same amount from end to end, and a position may be found upon the bar for which they will be identical throughout.

Under these circumstances, which are the only ones in which the Bunsen method in photometry is strictly applicable, the instrument may be used as a simple photometer, the setting for any wave length whatever giving the candle-power. For this purpose alone, viz., for the comparison of lights or similar character, the instrument offers certain manifest advantages over the various forms of the Bunsen photometer. In the course of the present paper I shall present some definite data concerning the relative sensitiveness of the two instruments when used in this way.

When the lights to be compared differ



See "Notes on a New Photometer."

both in intensity and quality, ordinary photometric indications possess no perfectly definite significance. In this, which is the more general case, the relative brightness of the spectra of the two sources varies with the wave length. For each region of the visible spectrum, however, a position upon the photometer bar can be found at which the brightness of the two spectra in that region will be equal, and the observations thus obtained, when extended over the entire spectrum, will afford data by means of which the differences in quality of the two sources of light may be definitely expressed.

In a recent paper read before the Institute (Transactions of the American Institute of Electrical Engineers, vol. 6, p. 183), for a considerable range of temperature, at least, the ratio between the intensities of a certain wave length of the spectrum of glowing carbon is identical with the ratio of candle powers as determined by the Bunsen photometer. The wave length in question, determined from the intensity of the spectrum of incandescent lamps at various candle-powers, I had found to be approximately $\lambda = 600$. M. A. Crova, in an important paper, since presented at the late electrical congress in Paris,* has pointed out the importance of this method of measuring the light from sources differing in temperature. The wave length which he has indicated for this purpose is $\lambda = 582$, which belongs to a region lying slightly farther toward the green than the one which I had adopted.

When the wave length of this region has been established beyond question, the photometry of lights which vary in color will have been reduced to a definite scientific basis. Instead of attempting to use the Bunsen photometer in measurements to which it is not adapted, we shall be able to deduce the relative candle-power of two sources of light from the comparison of a single wave length, and we shall be freed from the uncertainty arising from differences of color and from the personal errors due to the independent use of the two eyes in observation. The determination of candle-power will then be an operation of precision, even when the sources of light to be compared vary widely in temperature. It is in the opportunity of performing such observations upon the photometer bar itself, under conditions which do away with many of the sources of error inherent in the usual methods of spectrophotometry, that the chief advantage of the new photometer will be found to lie.

The following set of observations, taken with the new instrument, may serve to indicate one of the uses to which it may be put. The data are taken from an investigation now in progress in the Physical Laboratory of Cornell University. The object in view was to compare the spectrum of a novel type of gas burner with that of an ordinary argand burner. The two lamps were set up at the ends of a photometer bar five meters long, the bar, as already stated being divided into 1,000 equal parts. Readings were taken at six points in the spectrum. The purposes being to express the relative brightness of the two spectra, wave length for wave length, the intensity of that due to the argand burner was taken as unity throughout, and the brightness of each region of the spectrum of the flame under investigation was obtained in terms of that of the corresponding region of the spectrum of the argand. The results are given in Table 1.

*M. A. Crova: *La Lumiere Electrique*, vol. 33, p. 478.

The Essick Printer.

TABLE 1.

Comparison of the spectrum of a Welsbach burner with that of an ordinary argand burner, by means of the "horizontal slit photometer."

Color.	Wave Length	Light Ratio, Welsbach / Argand.	Probable error of a single observation. Per Cent.
Red....	702	$0.709 \pm .017$	2.45
Yellow.	589	$1.476 \pm .017$	1.14
	558	$1.760 \pm .023$	1.34
Green..	500	$2.595 \pm .047$	1.99
Blue...	466	$2.738 \pm .036$	1.30
Violet..	439	$3.090 \pm .073$	2.35
			1.76 (Average.)

Ten observations were made in each region. From observations by Miss Ida M. Hill.

I introduce these measurements here simply as an illustration of one line of work to which the instrument under consideration is adapted. A full description of the research of which they form a part, and which covers many other questions pertaining to the very interesting class of lamps with which it deals, will doubtless be published in due time.

As will be seen from the column of probable errors, the sensitiveness of the instrument is greatest in the region of the D line ($\lambda = 589$) and least in the extreme red and violet, where the light intensities are small.

A set of ten determinations made by the same observer with the Bunsen photometer, gave for the total light ratio of the two lamps,

$$\frac{\text{Welsbach}}{\text{Argand}} = 1.701 \pm .015$$

The probable error of a single observation in this series amounted to 0.89 per cent., a value somewhat smaller than that obtained with the new photometer in the yellow of the spectrum.

The number of observations is too small to afford a close estimate of the relative sensitiveness of the two instruments, but the results suffice to show that the "horizontal slit" photometer does not differ appreciably in accuracy from the Bunsen photometer when the latter is used in the comparison of flames of the same color.

When it comes to the measurement of sources of light that differ widely in temperature, the comparison is decidedly in favor or the "horizontal slit" photometer, the sensitiveness of which is not affected by difference of color. The error of the Bunsen photometer in candle-power measurement of the arc light, for instance, calculated from ten observations recently made upon the same photometer bar, the reference standard being an argand gas burner, was 2.65 per cent. (probable error of a single observation), a value more than twice as large as that of the "horizontal slit" photometer.

A comparison of the performance of the new photometer with that of a polarizing spectro-photometer of the type which is commonly recognized as affording the highest degree of accuracy, is likewise decidedly in favor of the former. Taking as a basis eight observations made by Dr. Franklin and myself in the study of a bat's-wing gas burner,* the observations covering eight regions of the spectrum, I find the error of a single observation, in the various regions, to have been as follows:

TABLE 2.

Probable errors of a single observation with a polarizing spectro-photometer, calculated from sets of ten observations upon various portions of the spectrum of a gas flame.

Wave lengths.	Probable error of a single observation. Per cent.
753	7.9
668	4.9
608	4.5
557	5.4
518	6.4
492	7.0
468	5.0
450	2.4
	5.2 (Average.)

The measurement of a fluctuating illuminant, such as the gas flame, is a line of investigation by no means adapted to exhibit any photometric instrument at its best; but as the errors of the horizontal slit photometer, already given, were calculated from sets of 10 observations upon such flames, I have selected for comparison similar sets of 10 upon sources of the same character.

The averages, viz., error of horizontal slit photometer, 1.76 per cent. (average for spectrum), error of polarizing spectro-photometer, 5.20 per cent. (average for spectrum), doubtless afford a fair indication of the relative performance of the two instruments in this peculiarly trying line of work.

At the last annual meeting of the Institute I had the privilege of presenting a brief study of certain personal errors pertaining to the use of the Bunsen photometer. The particular class of errors to which attention was called in that paper† are undoubtedly obviated by the use of the horizontal slit photometer; what new ones the latter instrument may introduce remains to be determined.

*American Journal of Science, Vol. 38, p. 160. See also Transactions of the American Institute of Electrical Engineers, vol. 6, p. 177.

†Transactions of the American Institute of Electrical Engineers, vol. 6, p. 335.

TELEGRAPHIC

.... Recent press despatches from Hong Kong state that the telegraph lines connecting Tonquin and China, by way of Yunnan capital of the province of the same name, have been opened for business.

... The Western Union Telegraph Company has secured control of the Bay State Telegraph Company for a term of 99 years, a copy of the lease filed in New Haven last week showing the rental to be $12,000 annually. The Bay State Company has six copper lines from New York to Boston, and also wires south to Baltimore.

.... The twelfth annual election of the South Jersey Telegraph Company, last week, resulted as follows: James Merrihew, president; W. B. Gill, vice-president; C. A. Junk, secretary; W. J. McLaughlin, treasurer. These directors were chosen: Charles A. Tinker, H. M. Plush, Henry Bentley, W. T. Westbrook, W. B. Gill, George Merrihew and James Merrihew.

.... Postal telegraphy, Mr. Wanamaker's particular hobby, and Dr. Norvin Green's particular abhorrence, is to have a final hearing before the post office committee of the House this week. Mr. Wanamaker will be on hand to tell how economically the telegraph business could be conducted by the government, and Dr. Green will move the committee to compassion by his pathetic recital of the Western Union's struggle to serve the people and keep out of debt.—*Kansas City Journal.*

A New Telegraph Company.

The N. J. Postal Telegraph Co. was incorporated, by filing of articles in the Secretary of State's office, at Trenton, last week. The incorporators are Everett Frazer, Her Korean Majesty's Consul-General at New York, who resides in Orange; Joseph A. McClary, Rahway, associated with the Mackey-Bennett Cable; Francis R. Upton, Newark, with the Edison Light Company; Edward Allen, New York; Henry P. Winter, Orange, and Philip Lowry, of this city. The capital stock is $50,000, paid in, which may be increased at any time. It is proposed, at the outset, to construct lines through Newark, Orange, Elizabeth, Rahway, Plainfield, New Brunswick, Perth Amboy, Keyport, Matteawan, Middletown, Red Bank, Long Branch, Asbury Park, Ocean Grove and Spring Lake, and subsequently touch nearly every town in South Jersey. It will operate in connection with the Mackey-Bennett Cable Company, and proposes to compete with the Western Union.

The Essick Printing Telegraph.

Our illustration on this page shows the latest form of the Essick printing telegraph instrument. The present machine is considerably smaller than those first made and has been greatly simplified and improved in its mechanical details. A representative of the Electrical Review was present at the trial of the first instrument set up in Boston a few months since. The instrument received and transmitted messages from and to New York in a perfect manner. Although the main principles of the printer remain the same, the change in details has much improved its appearance and facility of operation.

The great advantage of these machines is the fact that they use a very small current and any number of machines may be operated on the same circuit. A speed equal to that attained on an ordinary type-writer is possible on the Essick printer. The instrument itself is a check on the message sent, as a copy is printed before the sender.

No better instrument could be devised for use on police station circuits and for receiving press despatches. The messages are printed in page form and do not need to be re-written or transcribed.

* * The Greenwich Gas & Electric Light Company of Greenwich, Conn., are just putting in a 100 horse-power tandem compound engine, supplied by the Ball Engine Company, of Erie, Pa.

* * The Thomson-Houston Company will put in the electrical equipment for the Duluth Street Railway Company. The contract was let last week. The work will cost about $150,000. Operations will be begun at once, and the first line will be finished inside of 60 days.

* * Under the local franchises there is no limit to the speed of electric cars in Milwaukee, and a maximum of 20 miles an hour is frequently reached on the West Side Line. Alarmists have inaugurated a movement looking to an ordinance which shall compel a reduction in running time and avert calamities.

* * M. Jablockoff, of electric candle fame, makes a strong argument in favor of going back to chemical reactions for the production of electricity as a motive power. The dynamo machine does not utilize more than 10 per cent. of the fuel, while more than 90 per cent. can be obtained under favorable circumstances in electro-chemical combinations.

* * A recent invention consists of a fender for street railway cars run by electricity. It presents a platform capacious enough to receive a victim so unfortunate as to be caught upon the track before a car. At a slope before it, is a heavy four ply rubber belting, pliable enough to pass over paving stones and similar objects, but sufficiently rigid to prevent an arm or leg from being drawn under the fender.

* * Arrangements are now being made between the Keith Electric Manufacturing Company and the San Francisco Electric Power Company for the consolidation of the two companies. The machines used by the latter are all of the Keith pattern, and the new arrangements is proposed as a means of reducing the outlay necessary for the plant and thus lower the price to consumers. Prof. N. S. Keith, the inventor of the Keith dynamo and motor, will in all probability succeed to the management of the new company.

GENERAL NOTES.

The New England Telephone Company operates 91 exchanges, with 17,275 subscribers.

The graduation exercises of the Class of 1890, of the Massachusetts Institute of Technology, Boston, will be held Tuesday, June 3d. The REVIEW acknowledges a courteous invitation to be present.

A conference was opened at Adelaide, Australia, last week, the object of which is to effect a reduction of postal and cable rates between the Australian colonies and Europe. The postmasters of all the colonies except New Zealand were present.

W. S. Sheldon, of Martin's Ferry, W. Va., has invented an electric signal for railroad crossings, whereby as the train approaches the crossing it indicates its approach by ringing an electric gong, displaying a red flag and a sign with "train coming" painted on it. At night it shows a red light instead of the flag, and the sign of train, having been painted on glass and illuminated by a small incandescent lamp, can be seen also.

At the annual meeting of the Winnipiseogee Bell Telephone Company, held in Laconia, N. H., last week, the following officers were elected: President, Elijah H. Blaisdell; treasurer, Samuel B. Smith; clerk, Edwin C. Lewis; general manager, Frank H. Champlin; directors, Elijah H. Blaisdell, Samuel B. Smith, Frank H. Champlin, George F. Mallard, Moses Sargent. It was voted to declare a dividend of $1 per share payable on and after June 1.

The Electrical Engineers.

At the general meeting of the American Institute of Electrical Engineers, held in New York, on the evening of May 20th, the following officers were elected: President, Professor William A. Anthony, Manchester, Conn.; vice-presidents, Francis B. Crocker, Frank J. Sprague and Joseph Wetzler, all of New York City; managers, H. Ward Leonard, P. B. Delany, H. A. Foster and J. C. Chamberlain; treasurer, George M. Phelps; secretary, Ralph W. Pope. These vice-presidents and managers are in addition to those whose terms of office do not expire this year. The places made vacant by the death of Major O. E. Michaelis and the resignation of Henry Van Hoevenburgh, will be filled by the Council after the election of officers. Lieut. Wilkes read a paper on "Electricity in the Navy."

The Boston meeting, held the following day, at the Massachusetts Institute of Technology, was attended by a number of members. Papers were read, and the general programme of the meeting, as published in the ELECTRICAL REVIEW, was carried out.

The following gentlemen were in attendance: J. S. Cobb, C. J. Spike, A. Floyd Delafield, G. G. Grower, G. B. Prescott, Jr., J. Wetzler, J. P. Wintringham, A. A. Knudson, W. J. Hammer, R. W. Pope, R. W. Ryan, F. B. Crocker, W. S. Turner, C. S. Bradley, Caryl D. Haskins, F. A. Pickernell, H. H. Eustis, F. B. Herzog, Capt. E. Griffin, G. W. Mansfield, Louis Bell, J. C. Chamberlain, E. L. Nichols, A. M. Young, S. B. Paine, J. A. Miller, John C. Lee, Almon Robinson, A. A. Dixon, Theo. Stebbins, Chas. K. Stearns, E. W. Rice, Jr., R. N. Bayles, C. A. Terry, O. K. Stuart, W. C. Benbow, C. Wellman Parks, G. A. Hamilton, W. A. Anthony, H. Lemp, E. W. Mix, Leo. Daft, S. E. Doane, A. S. Kimball.

At the morning meeting Prof. Elihu Thomson presided in the absence of Prof. W. A. Anthony, of Manchester, Conn., who was elected president of the Institute at the annual meeting held the day before. The meeting was called to order at 10 o'clock, and an address of welcome was delivered by Gen. Francis A. Walker, president of the Institute of Technology. He spoke of the appropriateness of the meeting being held in the hall of an Institute, the members of which have contributed so much to electrical research and investigation. He concluded with a most hearty welcome to the engineers on the part of the Institute of Technology in which he said that he thought it especially appropriate that the members should meet in the Institute where some of them had gained their electrical training. Prof. Elihu Thomson responded briefly and happily.

The first paper was by Wilfred A. Fleming, of New York, on "Electric Lighting in the Tropics." This was followed by a long and technical paper on the "Life and Efficiency of Arc Light Carbons," by Louis B. Marks, M. E. Dr. Edward I. Nichols, of Ithaca, N. Y., described a new photometer, illustrating its mechanical construction by drawings on the blackboard. A paper on the "Magnetic Data of the Sprague Street Motor," by H. F. Parshall, concluded the morning session.

Prof. W. A. Anthony, president of the Institute, occupied the chair at the afternoon session, and opened it with congratulatory remarks. A paper, by Oscar T. Crosby, of New York, entitled "The Limitations of Steam and Electric Transportation," occupied the first hour of the afternoon. Mr. Crosby thought that the problem whether electric engines will supersede steam locomotives would depend largely on the comparative expense.

This was followed by a purely technical paper on the "Practical Aspects of the Alternating Current Theory," by Dr. Michael J. Pupin, of New York. An automatic electric welding machine, with experimental demonstrations, and a paper describing its adaptability to the welding of various kinds of metal, by Herman Lemp, Jr., of Lynn, next occupied the attention of the electricians. The last paper was on the "Industrial Utilization of the Counter Electromotive Force of Self-Induction," by T. D. Lockwood, at the conclusion of which the Institute adjourned to the Parker House. Seven long tables were required in the large dining room at Parker's to accommodate the more than 200 members and guests of the Boston Electric Club. Mr. Henry B. Cram, president of the Club, presided, and, after the dinner had been served, introduced, as the speaker of the evening, Mr. S. E. Barton, president of the Mutual Electric Insurance Company, of Boston, who spoke on "The Relations of Fire Insurance to Electrical Insurance, as Viewed from a Fire Insurance Standpoint."

In the course of Mr. Barton's remarks, he said that much unfair criticism had been hurled at the electric wires, but as a matter of fact, the electric wires, according to official reports, caused less fires than rats and matches, or lighted cigar stubs.

Professor Anthony said that electrical appliances had come to stay.

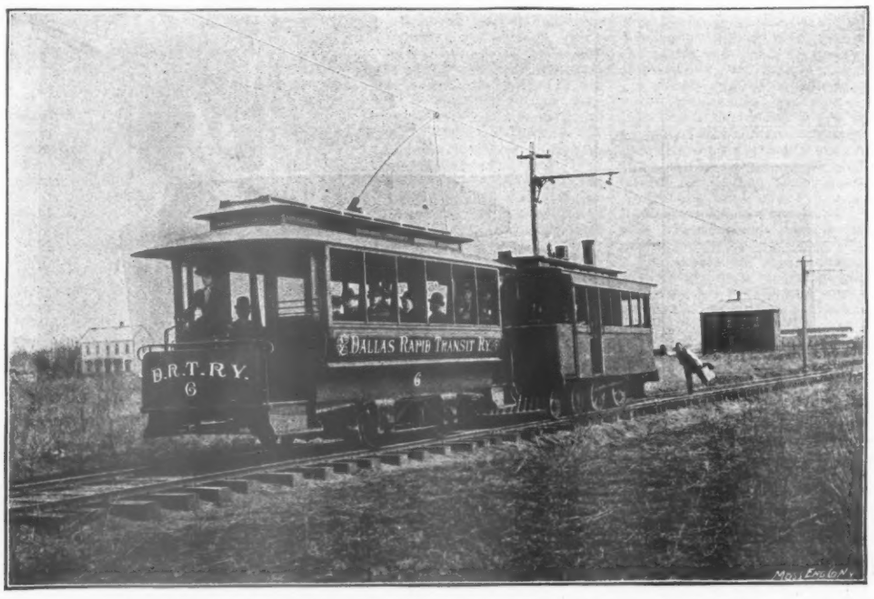
"There is no experiment about it," said he, "and I see in the application of electricity great prosperity. Fifty years from now we shall find the electrical problem so far advanced as to challenge our sincere admiration." Assistant Superintendent Dennet, of the power station of the West End Street Railway Company, then told of the West End's great electric system, and termed Boston the great electrical metropolis of the world.

Capt. Eugene Griffin, general manager of the railway department of the Thomson-Houston Company, spoke in a humorous vein, and was followed by C. F. Pritchard, president of the New England Association of Gas Engineers, who explained all the tricks of the trade. Prof. E. L. Nichols, of Cornell University, spoke of the good accomplished by electrical courses in the college. Letters of regret were read from Mayor Hart, Gen. Francis E. Walker and Col. G. H. Campbell.

The president of the Club, in adjourning the meeting, expressed the hope that the Institute would soon again meet in Boston, and cheers were proposed and given for the Club and the Institute.

At 9 o'clock on Thursday morning, in response to a cordial invitation extended by Prof. Wm. Cross, of the Institute of Technology, the engineers met in the electrical laboratory of that institution and were courteously shown over the magnificent building. At 10 o'clock carriages awaited the engineers, and they were taken to the central power station (formerly Hinckley Locomotive Works) of the West End Railway Company, under escort of Mr. L. S. Dumoulin, superintendent electrical department of the railway named. By order of President Henry M. Whitney, the guests were escorted over the entire power station, and afterward were taken in carriages to the Park street station of the Brighton Electric Railway, and as soon as they were aboard the three special cars which had been assigned for their use, they were whisked over the rails to Chestnut Hill at the rate of 12 miles an hour. The party returned to the city and were sumptuously entertained at the Parker House by the West End Railway Company.

At 2 o'clock several officers of the Thomson-Houston Electric Company met the engineers and escorted them *via* the Boston, Revere Beach and Lynn ("narrow gauge") Railroad, to the factories of the company, at West Lynn, and on arriving there were shown over the company's immense works and also through the factory of the Thomson Electric Welding Company. The guests were divided up into small parties and such well-known electric experts as Professor Thomson, A. L. Rohrer, Geo. W. Mansfield, Geo. F. Curtis, each took a party in tow, and in this way the most interesting features of the mammoth factories were quickly gone over and heartily relished by all. The party returned to Boston by the 4.15 o'clock train. Those of the members who did not take the earlier evening trains (or Fall River boat) for New York, spent their remaining few hours at the "Hub" most delightfully at the Boston Electric Club, or enjoyed an entertainment at one of the theatres, and took the midnight train on the Shore Line southward.



VIEW ON THE DALLAS ELECTRIC RAILWAY.—A LADY IN CHARGE OF A MOTOR CAR.

Electricity Supplants Steam.

Electric railroading has received a great deal of attention in the Southwest, and this part of the country is fully awake to the advantages of electric power for car propulsion.

Texas has now two electric railways in operation on the Sprague electric system, and others are in course of construction. One of the roads in operation is the Dallas Rapid Transit Railway, a view of which is shown in this issue of this paper. The motive power for operating the cars on this railway was formerly furnished by a steam dummy, which has now been abandoned for the more modern power. The view shows one of the electric cars drawing the old steam dummy. The engraving was made from an instantaneous photograph, and shows the ex-engineer of the steam engine trying in vain to catch the train, which is going so rapidly that he is left behind.

A new feature (we might say features) in connection with this view, which shows very clearly the easy manipulation of the electric car, is the fact that the motor car is being operated by a young lady who is in charge of the controlling switch, while another young lady is acting as conductor. By way of comparison it might be mentioned that the steam dummy required an engineer and fireman to run it besides a train conductor on the train. The electric road has proved very popular in Dallas, and has carried a large number of passengers since its installation. The method of overhead construction used is the single bracket, as shown in the illustration.

Electric Lighting in the Tropics.

BY WILFRED H. FLEMING.—READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, MASS., MAY 21, 1890.

One of the chief difficulties that an engineer experiences who is called upon to install a plant of any considerable size in tropical countries is the trouble of procuring any kind of skilled labor for this particular class of work. Another difficulty is that he is so far from his base of operations—the factory—which will often lead him to depend upon himself in overcoming obstacles that arise from time to time as the work progresses. Language and the heat, as well as fevers, are minor affairs.

Electric lighting has already gained many warm adherents both in the East and West Indies. More especially in the former, where plants of considerable capacity have been in active operation for the past eight years. It is especially adapted for use in houses in warm climates, such as that of India, where the old-fashioned "Punkah" is in daily and nightly use for cooling the rooms, accompanied with its attendant noise as the "punkah wallah," a servant, pulls it backward and forward, causing the continual flickering of the lamps or gas. That system will, in time, I hope, give place to the noiseless motor fans and steady incandescents, thus enabling the Anglo-Indian to read and rest in comfort.

A central station plant that the writer was engaged upon lately in one of the chief cities of the West Indies, would compare favorably in size and equipment with one situated in a city of a corresponding number of inhabitants in the United States. Alternating current dynamos of a capacity of 4,500 sixteen candle-power lamps were employed for lighting the chief stores, theatres and private houses, and 600 arc lights of 1,200 candle-power each, lighted up the main streets and parks.

It was at first intended to run a small plant in connection with the existing gas works, more as an experiment than with a view to actual financial success, but in the space of six months the station was more than trebled from its original capacity.

The people took to it from the start, paying cheerfully the prices that were demanded. To an indolent race it was a great boon. Money to them, it would appear, was of less account than the trouble and work called upon to go around and light up the different oil and gas lamps, since all the lights were switched on the different circuits at sunset. In the tropics, as is well known, there is no twilight. Darkness comes on within ten minutes of sundown, and the whole plant practically goes into operation at once.

The construction work on this particular plant was necessarily somewhat slow, as men accustomed to erect a 30 or 45 foot pole took their time to do so, in which operation they received the appreciation of the usual army of idlers. Poles suitable for carrying a number of circuits had to be imported from the United States, as well as the ornamental wooden columns for supporting the lamps in the parks and public squares. Poles of native growth could not be found straight enough, and even if of sufficient length, were weak. Some poles could have been had from a tree called the iron wood tree. This wood, however, is of so close a grain and so very heavy that it was out of the question to use it. Many of the business streets were not more than from 20 to 30 feet across, including the sidewalks. Moreover, as curtains or awnings are stretched overhead from side to side by the owners of the stores to shelter and protect their goods from the sun's rays, it was impossible to erect a pole line down these streets. I found it better to run a two-inch iron piping up the side of the houses every 150 feet to a point six feet above the coping stone and then attaching to the top of this pipe a T, inserting in this T wooden cross-arms, to which the insulators were attached in the usual manner. It must be borne in mind that the houses are not of very great height. Where this arrangement was impracticable, owing to the varying heights of the houses, I inserted strong iron brackets in the buildings, set in with cement and well painted with rust-proof paint.

In India considerable care has to be exercised in putting up a pole line. If you want your work to stand any length of time, the base of the poles for one-sixth of their length must be thoroughly well creosoted to resist as far as possible the ravages of an insect called the white ant or "termite." These insects live on wood. They attack even the wood-work of the houses and soon reduce the thickest timber to a mere shell. They live in trees and construct nests of great size like small sugar casks made of particles of gnawed wood and cemented by a kind of gluten. They are so strongly attached to the branches that they cannot be shaken down even by violent storms. It is a good plan to paint the poles eight feet above the surface of the ground with good gas tar if obtainable. In these climates special attention should be given to protecting the working parts of arc lamps, owing to the fact that rain occurs only for about three months of the year, and to make up for this loss the humidity of the atmosphere is remarkable. It is not at all infrequent to find early in the morning the bottom carbon holders full of water, unless provision is made for draining this off. During the hot season a breeze springs up between 9 and 10 o'clock in the morning and, the ground being dry, the dust is terrific. Insects of a large size—much more so than those found in the northern climates—bats and small birds, attracted by the glare, are found either in the globes or lying at the base of the lamp posts in large quantities every morning, and the wholesale slaughter that takes place nightly seems to have no effect in diminishing these pests.

It was found better, therefore, on the arc service to give a man about 25 lamps to trim and clean per day, and the native entrusted with this work was held responsible, and if the lamps were found in a dirty condition he was fined, which usually had a good effect.

In the construction of station buildings one is guided much by the facilities for procuring stone, brick or other suitable material in that particular locality. Galvanized iron is sometimes used for roofing, but more frequently roofs are constructed of a sun-baked clay tile, provision being made, as is usual, for an ordinary wire tower for distributing the various circuits. A point to be noted is that the engineer should construct his rain gutters for taking off the storm water at least double the size that is ordinarily allowed for temperate climates. Roofs and the outsides of the buildings are whitewashed.

To give an idea of the heat from the sun, I may mention that I had to replace considerable quantities of insulated wire after it had been up only a short time, the insulation in places sagging right away from the copper wire and finally dropping off. During the rainy season prevailing in the West Indies, in the months of June, July and August, and in the East Indies, known by the name of the southwest monsoon, and prevailing from May to the latter part of August, electrical storms occur almost daily. They are often exceptional in violence, and much trouble and anxiety arises from possible damage to line, lamps and dynamos, even though protected by good lightning arresters.

While a heavy storm was in progress, one night last summer, in the West Indies, I noticed when in the station a curious effect of a flash that fused the lead strips on an ordinary saw-tooth arrester connected with one of the incandescent circuits. The strips were entirely destroyed or volatilized, and what was before a polished plate of brass was now tarnished with a film of the lead vapor, and there was distinctly marked, as if photographed on the plate, a zig-zag streak in all appearance like a photograph that had been taken of lightning. Engineers, during the prevailing season of storms, should take particular pains that their lines and machines are thoroughly well protected, and that the arresters have good earth connections.

A sad case came under my notice that happened at a temporary installation for illuminating a camp, in Poonah, in the Bombay Presidency, with arc lamps in honor of a visit of an influential Rajah. Whilst the festivities were taking place in the evening, a heavy storm occurred. Lightning entered on the line, no provision had been made for diverting its course, and it destroyed the dynamo besides killing the native oiler who just at that moment was engaged in filling up the oil cups on the bearings. He was either thrown or fell across the commutator end of the dynamo, as he was found in that position, his hands much burnt as well as his feet.

In the year 1877, the first commercial arc lamp was in use at the offices of the Bombay *Times*, and if I remember correctly, it was the first light shown in the Indian Empire. From that date on the demand for lighting has been on the increase; but pretty nearly all the work has been confined to isolated work and small central stations, cotton mills, sugar and indigo plantations, government buildings and large private dwelling houses. Places of business and offices do not require lighting, as business is conducted by the merchants only from 7 o'clock in the morning till 4 in the afternoon. The inhabitants of hot climates necessarily spend much of their time out of doors and are fond of social gaiety. They have been famous for centuries for skill in illuminating, and this fact has added much to the popularity of arc and incandescent lamps, which, as is well known, particularly lend themselves to artistic illuminating purposes. From this knowledge, in the early part of the year 1895, I imagined that it would be a financial success to get together a traveling portable electric light plant, consisting of a vertical boiler, engine and two dynamos, one an eight arc light machine and the other a 100 light incandescent, both mounted on a stout frame which rested on a pair of bisel trucks. This work was carried out, and I was kept actively employed for many months in going round to different large Indian estates and native palaces for the fetes that attend the various religious and family ceremonies that the wealthy natives are fond of indulging in. Large sums of money are spent and the festivities often last for a week or longer. It turned out to be, as I surmised it would, a regular "bonanza," until on one occasion, in bringing the unwieldly contrivance down a steep hill, on one side of which was a ravine, it fell over; and, it is needless to relate, that the whole apparatus was seriously damaged. I found it would not pay to patch it up again, so, after stripping everything that was portable, I left the remainder to lie and rust in the tropical vegetation.

Owing to the high price of coal, which is a costly article in the tropics, ranging from $8 to $50 per ton delivered, it is well to employ the most efficient and economical engine for motive power, more especially for central station work. In the station previously referred to, we were running with high speed compound condensing engines with satisfactory results.

In many sugar plantations in the West Indies, where the installations are of a comparatively small size, economy in this direction is not practiced as the amount of steam used is not missed, the boiler capacity on estates ranging from 100 horse-power, to one at Cienfuegos, Cuba, of 2,500 horse-power. It behooves the engineer, however, who has charge of a plant to exercise considerable care and watchfulness over his native firemen. The natives, as a rule, I have found, if treated with kindness and forbearance, show an aptitude in learning and taking hold that is often remarkable, more so than with some of their brethren of a lighter color who, because they have been taught how to start and stop a dynamo or trim an arc lamp, give themselves all the airs of an expert in electrical matters, and have got beyond that stage when they are willing to be instructed or to be obedient to orders, an unwillingness that sometimes leads to disastrous results.

The types of machines chiefly in use in the East Indies are those of English and French manufacturers, Siemens, Gramme, Silvertown and other well-known types. Those in use in the West Indies and South and Central America are generally of American make, and the market is not a small one. The great strides that both the foreign and home companies have made in the last two or three years in the supply and equipment of electrical plants for these distant lands are very evident signs that this particular business is receiving great attention at the hands of local merchants, planters and city or town officials, and that they are more and more influenced by the many advantages to be gained by the use of electric lighting. Planters find now that it is much to their gain in a financial way. In former years, for example, the facilities of shipping their produce were restricted, and the work was done in daylight and slowly. Now, with weekly and almost daily sailings, it is an absolute necessity that they should get their produce ready with the quickest despatch possible, and this they do with the aid of the electric light. When an engineer is called upon to install or take charge of an electric light plant, it will be well for him to insist pretty closely not only that all the materials specified in the estimates have been shipped, but that every class of tool requisite for constructional work is included. Much time is lost and much trouble is made when you find that your outfit does not include "climbing spurs" or draw vises and other important articles. I have known engineers who have had expensive testing sets, Wheatstone bridges, reflecting galvanometers and other delicate instruments, sent out with them, and then found that they had few or any tools to work with, and that the nearest hardware store was many miles away through a rough country, and even then, the store when reached did not contain the requisite goods, there having been no stock kept because there was no demand made for them. Spare armatures, complete sets of arc lamp apparatus, as well as duplicate parts of dynamos, spare brasses and gear for engines and tubes for boilers should always be included and it should be seen that they are shipped.

Apart from the vicissitudes incidental to life in the tropics, there is, I think, always a satisfaction and pleasure in the successful completion of an installation, knowing as one does that it is a potent factor in the greater civilization of those countries, demonstrating to the inhabitants, who have heretofore depended on artificial illumination of the same primitive character and manner as their forefathers used through ages past, what science, aided by her lieutenants, "pluck and energy," can accomplish.

—— The Westinghouse Electric Company has just sold a 750-light dynamo, which will be used toward dispelling in a measure the darkness which nightly gathers around the town of Chanute, in the State of Kansas.

ELECTRIC LIGHT NEWS

—— The Pensacola Electric Light Company, of Pensacola, Fla., have just added to their plant a 100 horse-power Ball engine.

—— The power of the arc lamps in New Haven, Conn., is to be reduced from 2,000 to 1,200 candle-power, and more lamps distributed throughout the city.

—— Saco, Maine, has decided to adopt the Westinghouse alternate current system of illumination. The initial plant at Saco, will consist of one 750-light incandescent dynamo.

—— In the Supreme Court, last week, Elihu Root filed a discontinuance of the suit brought by the electric light companies against the subway officials. This suit was practically declared off some time ago, when it was decided not to award a contract to a new company for the subway work.

—— Owing to the rapid increase in the business of the Brush Electric Company, of Baltimore, that organization has found it necessary to increase the capacity of its incandescent plant by the addition of a Westinghouse 3,000-light alternate current dynamo. This machine will be shipped immediately and installed at the earliest possible moment.

—— The Wilmington City Electric Company, of Wilmington, Del., has for some time been contemplating extensive improvements in its electric light plant, owing to the increase of patronage on the part of the citizens of Wilmington. The company has just contracted for a new 750-light machine, of the alternate current incandescent system, and no time will be lost in the installation.

—— Connersville, Ind., is to have the electric light. An electric light company recently organized at that place has just closed negotiations with the Westinghouse Electric Company for a 750-light incandescent dynamo and two 40-light arc dynamos, all machines to be of the alternate current type. Mr. J. W. Huston, treasurer of the United States Company, is the president of the Connersville Company.

—— The United Electric Light and Power Company, of New York city, has voted to increase its capital stock by $200,000, making the total amount $5,000,000. The increased stock will be entitled to a preference of six per cent., and will be convertible at any time before July 1, 1893, into common stock, share for share. The stock is offered at par, and the proceeds will be used in the extension of the business.

—— The following petition, signed by some 2,000 citizens of Brooklyn, will be sent to the Board of Aldermen:

BROOKLYN, N. Y., May 19, 1890.

To the Honorable the Common Council of the City of Brooklyn:

GENTLEMEN: We, the undersigned taxpayers and residents, believing that electric lighting, both public and private, in this city of Brooklyn costs more than in the city of New York, and very much more than in most of the smaller cities of other States, and that the cause of such excess of price in our city is that for a number of years past competition in that business, which would have tended to lessen the price and improve the quality of the lights, has been prevented; and believing that the Brooklyn Electric Light and Power Company, of this city, is engaged in an honest effort to establish its business and furnish a better system of lighting for less money than is now furnished, respectfully requests you, your representatives, to grant to the said company the same privileges as those now enjoyed by other companies operating in this city by your consent, and on the same terms and conditions, in order that we may be no longer deprived of the benefits of competition, and also that the company may secure the right to transact a legitimate business, to which it is entitled.

ELECTRIC CLUBS.

WHAT IS GOING ON AT THESE POPULAR ORGANIZATIONS.

Chicago Electric Club.

President Frank G. Beach was a New York visitor recently, and met with a pleasant welcome from his friends in the New York Club.

The Chicago Electric Club has perfected new arrangements with the restaurant service, whereby orders for lunches and midday meals may be given in the Club rooms, which will be served by Kinsley in his main dining-room. It is expected by this arrangement that a quicker and altogether more satisfactory service will result. To make this new arrangement a success and an important feature of the Club, as it is desired to be, each member is asked to be present every day, or as often as possible, between the hours of 12 and 2 o'clock.

Wisconsin Electric Club.

The New Rooms of the Wisconsin Electric Club, in the Loan and Trust Building, Milwaukee, were formally opened on the evening of May 15th. After a short address, delivered in the Club rooms, by President A. J. Rogers, the members adjourned to the Commercial Club, where a fine banquet was served. A number of witty speeches were made. Mr. Bradshaw read a humorous poem, and President Rogers prefaced the toasts with a short address. John E. May responded to the toast "The Advancement and Application of Electricity in Our State;" E. H. Bottum to "Electric Cranks;" A. J. Shaw to "Electric Cranes;" D. J. Whittemore to "What I Don't Know About Electricity," and Peter McGill to "The Electric Telegraph." Other responses were as follows: "The Telephone," John D. McLeod; "Automatic Fire Alarm," Wm. C. Shæfer; "Electrocution," Harry Sawyer; "Electric Cars," John A. Hinsey; "Storage Batteries," Alex Bevan; "The Electric Press," J. B. O'Hara; "The People and Electricity," R. C. Spencer; "The Phonograph," H. D. Goodwin.

New York Electric Club.

Considering the season of the year, the number of members who visit the Club is very large. A little later on those of the members who cannot get out of the city for a vacation will appreciate more than ever the cheery, well-kept Club house, and many hot evenings will be spent within its portals. An easy chair, an electric fan, a genial companion, a good cigar, a *crème de ménthe!* Are these comforts to be compared to a crowded hotel and mosquitos?

The Cuisine of the Club is still kept up to the high standard of excellence which has always been the rule here. It is very seldom that members go elsewhere than the Club for a snack after the theatre.

The Click of the elusive billiard and pool ball is a regular evening accompaniment to the cheerful hum of conversation on the floor above. When some of the novices at pool attempt to make more than one ball at a shot it is wonderful how the pockets in the table shrink up to almost a solid cushion.

Recent Visitors from out-of-town: Fred. W. Royce, Washington, D. C.; R. E. Dunstan, Plantsville, Conn.; Walter McIntire, Philadelphia; W. R. Kimball, Boston; F. G. Beach, Chicago; J. E. Wilkinson, Williamsport, Pa.; F. A. C. Perrine, Trenton, N. J.; A. A. Knudson, St. John, N. B.; R. B. Owens, Greenwich, Conn.

Boston Electric Club.

Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, was a guest at the "Crank's" dinner, on Thursday evening.

Mr. Henry A. Whitney, president West End Railway Company, of this city, has made application for membership as an active member. It is expected that other officers of the West End railway will soon follow Mr. Whitney's example.

Mr. S. E. Barton's interesting paper read at the Club dinner at the Parker House, Wednesday evening, was a sound and truthful document relative to central electric light station insurance. The paper will be found in another column.

The Dinner given by the Boston Electric Club to the American Institute of Electrical Engineers, at the Parker House, Wednesday evening, May 21, was the most successful of the many enjoyable events afforded by this growing and progressive electrical organization. Nearly 200 gentlemen participated in the occasion, over one-half of this number being members of the Club. The arrangement of the tables and decorations could not be improved upon; and the bill of fare would have done credit to Delmonico. By the arduous labors of Treasurer F. J. Boynton and of the House and Entertainment Committee—Messrs. Rohrer, Stiles and Wright—the dinner proved a success in every detail.

The Telegraph Club of New York.

The New York Telegraph Club, composed of operators working in the principal telegraph offices in this city, was formed about two years ago with a few members, in two small rooms at 48 Church street. Its membership roll has grown so that it became necessary to move to larger quarters. The second floor of the building 32 Cortlandt street was fitted up at a cost of $3,000. The formal opening occurred last week. E. E. Brannin, president of the club, was presented with a crayon portrait of himself, which is to adorn the walls. Richard Kane made the presentation speech. The ladies of 195 Broadway sent a silver ice pitcher. The club is in a prosperous condition. The Western Union Telegraph Company recently contributed $1,000 towards its support.

St. Louis Electrical Exhibition.

Two of the three judges for this exhibition, which will be held in the fall, have been selected. They are E. R. Weeks, of Kansas City, and Carl Hering, of Philadelphia. The third judge is now being selected by vote by the electrical men throughout the country. Prof. Rowland, of Johns Hopkinss University, and Dr. Otto A. Moses of New York, are in the lead.

A New Brush System.

A whitewasher working at Macy's big dry goods store, one day last week, left his brush leaning against an insulated electric wire. The insulation was eaten away by the damp lime on the brush. About 10 o'clock at night a battalion of fire engines lined up in front of the building. The brush had operated an automatic fire alarm.

Electric Headlights.

Hearing that the light had already been adopted by the Indianapolis, Decatur and Western Railroad, and desiring to learn of its operation, the *Railway Age* sent a representative, a few days ago, to Decatur, Ill., with instructions to get on an engine that makes the night run from Decatur to Indianapolis. The distance is 153 miles, the train leaving at 10.30 P. M. and arriving at 3.50 A. M. Engine No. 1, in charge of Mr. John B. Burns, the oldest engineer on the road, made the trip that night. This was one of the first of the I., D. and W. engines to be fitted up with the light—some six months or so ago. The report handed in is that the light is "wonderful." The night was dark and cloudy and on a straight track the crossing fences leading to cattle guards were seen more than a mile away. For instance, selecting a crossing fence as far ahead as it was possible to see, there were 33 telegraph poles counted before the fence was reached, while with the ordinary oil light three poles ahead is all that could have been seen. Rabbits were plainly observed running along and across the track a half a mile ahead, and while the track and right of way were so brightly lighted from the pilot to so far ahead, the fence and poles directly opposite the cab could hardly be seen at all. Once in a while a cat would be seen running along between the rails a half a mile or so away. When attracted by the light it would turn and face the engine and its eyes would look as large and bright as a signal lamp. The light is thrown to a great distance from either side of the track, showing up all side tracks, switches, etc.

Another feature noticed was the reflection from the light up in the air, which is certainly a great advantage around curves and cuts, as the reflection can be seen where the light is shut out from direct vision by any cause.

Kemmler Loses.

THE U. S. SUPREME COURT DECIDES AGAINST HIM.

The arguments of Roger M. Sherman and New York State Attorney-General Tabor, before the United States Supreme Court, in the Kemmler electrocution case, were able, exhaustive and exceedingly interesting. Mr. Sherman read a very carefully prepared argument, while Mr. Tabor's statement was mainly extemporaneous. Both lawyers showed perfect familiarity with all the details of the case. The principal point of contention was over the application of the clause of the Federal Constitution which declares that "no State shall deprive any person of life, liberty or property without due process of law," and that "cruel and unusual punishment shall not be inflicted." Mr. Sherman argued that the law of New York directing the electrical execution of criminals is unconstitutional, and cited many cases in support of this theory. Mr. Tabor gave references to quite as many cases to prove the contrary. He did not go into the electrical questions involved, but said it would be time enough to consider the great mass of evidence already taken after the court had decided the constitutional question.

Mr. Sherman insisted that the State had put the business in the hands of some young experimenters who have been trying to find out whether there are any adequate means of killing a criminal; that all the present scientific knowledge on the subject does not warrant the belief that adequate means can be employed, and that there is no certainty of anything except torture of the most horrible kind. He made one fine point against the proposed manner of execution by quoting the statute, which says that "*the current shall be continued*" until the convict is dead, and then showing that the dynamo selected for the purpose does not give a *continuous* current, but a very large number of intermittent currents. This caused some of the dignified judges, several of whom understand volts and amperes, to smile.

Chief Justice Fuller delivered the opinion of the Supreme Court of the United States, Friday of last week, denying the application for a writ of error in the case of William Kemmler, the murderer confined in Auburn prison, N. Y., under sentence of death by means of electricity. The opinion begins as follows:

"This is an application for a writ of error to bring up for review a judgment of the Supreme Court of the State of New York, affirming an order of the County Judge of Cayuga county, remanding the relator to the custody of the Warden of the State Prison at Auburn upon a hearing upon *habeas corpus.*"

The opinion, which is a lengthy one, concludes as follows:

"The enactment of this statute was in itself within the legitimate sphere of the legislative power of the State, and in the observance of those general rules prescribed by our system of jurisprudence; and the legislature of the State of New York determined that it did not inflict cruel and unusual punishment, and its courts have sustained that determination. We cannot perceive that the State has thereby abridged the privileges or immunities of the petitioner or deprived him of due process of law.

"In order to reverse the judgment of the highest court of the State of New York, we should be compelled to hold that it had committed an error so gross as to amount in law to a denial by the State of due process of law to one accused of crime. We have no hesitation in saying that this we cannot do upon the record before us. The application for a writ of error is denied."

The case will next come up before United States Circuit Court Judge Wallace, who made an order to operate as a stay of proceedings to save Kemmler's life until the Supreme Court could pass upon the questions involved. This order was issued with the understanding that counsel would immediately apply to the Supreme Court for a writ of *habeas corpus.* Their application for such a writ was thrown out of court, but a hearing on an application for a writ of error was allowed them, and it was this application which was, as shown above, denied. The same questions were involved in this hearing as would come before the Supreme Court on a motion for a writ of *habeas corpus,* the only difference being one of form and court practice. It is, therefore, supposed that Judge Wallace, when the order becomes returnable on the third Monday in June next, will vacate it, that being practically the understanding upon which the order was made.

In an interview, Warden Durston, at Auburn, said that he believed that Kemmler would be electrocuted some time in August. Whether he or the Sheriff of Erie county would electrocute him, would undoubtedly be determined next month. Kemmler can be taken before three courts to have the day of execution fixed—the Court of Appeals, General Term, and the Court of Oyer and Terminer, of Erie county.

A dispatch from Albany says: "The next step to be taken in the courts in the Kemmler case will be the argument of the appeal from the decision of the County Judge of Cayuga county, denying a writ of *habeas corpus* asked for on the ground of the unconstitutionality of the power conferred on Warden Durston in the execution of criminals, which power it is claimed to be vested in the Sheriff of the county wherein the conviction is had. The appeal will come up before the General Term at Buffalo on June 3. This appeal does not affect the death penalty itself, or the crime or manner of the execution, and it is expected that the General Term will dispose of it in time to allow it to be carried to the Court of Appeals at its Saratoga June session."

The Claims of Inventor Freeman.

Walter K. Freeman has brought suit against the United States Electric Lighting Company, in the Supreme Court of this State, before Judge Ingraham. Freeman makes a number of astonishing claims which, if proven true, will change the history of electric lighting. In his complaint Freeman avers that he invented the incandescent electric lamp prior to August, 1878, and sent a lamp to Edison, at Menlo Park, N. J., and that about two years afterward Edison announced the invention to the world as his own. He then asserts that Edison offered him $50,000 if he would refrain from mentioning the fact that he was in reality the inventor and had sent sample lamps to Edison. The lamp he claims to have sent to Edison embodies all the features of the Edison lamp, consisting of a high carbon filament of high resistance secured to platinum wires and enclosed in a glass globe from which the air had been exhausted.

Freeman now claims a residence in this city, but has been in business at Eau Claire Wis. He was at Racine in 1878, when he sent the lamp, as alleged, to Edison, and was subsequently taken into the employ of the defendant company during a part of the year 1882.

In his suit against the United States Electric Lighting Company he alleges that a written contract was made with that company in June, 1881, which provided that if a patent were obtained on Freeman's alleged inventions which should be superior to the patent which Edison had at that time obtained, the company should have the option of taking it or paying him $100,000. No patent was granted, and he claims that the company was derelict in pushing the claim. He lays his damages at $150,000, part of which is for salary due for failure of the company to continue him in its employment.

The defense contends that the contract was not made for the benefit of the company, that the defendant made the application to the Patent Office in his own behalf, and that his application was rejected as invalid. It is further claimed that Freeman secured the contract by false representations and pursuant to a scheme of fraud to get money and employment without giving anything of value in return.

Removals.

The Southern Bell Telephone Company has moved its general office in this city from 195 Broadway to the "Telephone" building, 18 Cortlandt street. A large and convenient suite has been secured in the fifth floor and so arranged by the artistic planning of Auditor Dutton that every member of the staff thinks he has the finest and most desirable location.

The U. S. Illuminating Company and the United Electric Lighting Company have opened particularly pleasant and well lighted offices in the second floor of the new *Times* building.

Plans for a new telephone exchange building at Chattanooga, Tenn., are about completed and work will shortly begin.

Life and Efficiency of Arc Light Carbons.

BY LOUIS B. MARKS, M.E., BEFORE THE GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, BOSTON, MAY 21, 1890.

From the experimental stage of arc lighting to the commercial application of the system to-day, little or no increase in the efficiency of the carbon points appears to have been made.

Now that our dynamos and lamps have reached such a state of perfection, the subject presents itself as pre-eminently important. The arc light pencil, considered as an individual part of the plant, is indeed a small thing, but in it undoubtedly lies the weak spot of the system.

It was with a view of studying the action of modern carbon pencils, that the investigations here to be described were undertaken. The carbons experimented upon were all of American manufacture, and were procured from five companies (A, B, C, D and E).

While the greater part of the research was upon the life and efficiency of the pencils, observations were also made in other directions.

The subject will be treated under the following heads:

1st. Structure of the carbons.
2d. Life tests.
3d. Efficiencies.
4th. Candle-power measurements.
5th. Observations of the arc and carbon points.

It is well known that the life and efficiency of a carbon depends upon the system in which the latter is burned. For instance, "the requirement of the low tension system seems to be a carbon that is hard, well plated and a good conductor, the latter being the most important.

"In the high tension system, on the contrary, hardness and conductivity seem to be of secondary importance. There is a tendency to 'flame' and burn unsteadily when a hard carbon is used in this system, and a softer one sometimes becomes necessary."*

It is interesting to note the methods employed by carbon manufacturers to attain the conditions above mentioned. In one of our largest carbon works, "forced" carbons, or those made by "squirting" the plastic material through a die, are manufactured for both high and low tension systems of lighting, to the exclusion of molded pencils. On the other hand, another company makes no forced carbons, but claims that its molded pencils are superior for either system. From the classification given below, can be seen the types of carbons now upon the market for both systems:

Carbon.	High tension.	Low tension.
A	molded	forced
B	"	molded
C	"	"
D	forced	forced
E	molded { forced }	"

One of the first things that suggested itself was the study of the structure of the various samples submitted.

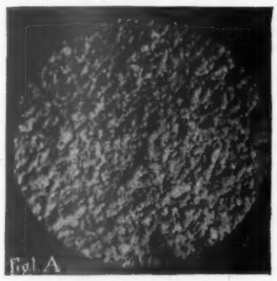


Fig. A

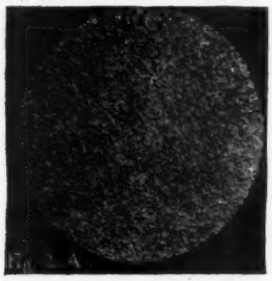


Fig. A

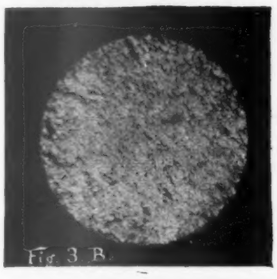


Fig. 3 B.

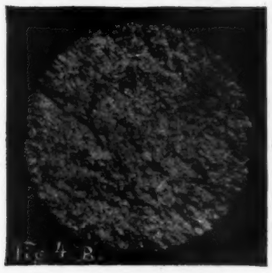


Fig. 4 B.

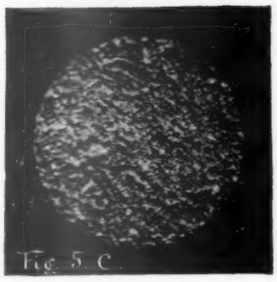


Fig. 5 C.

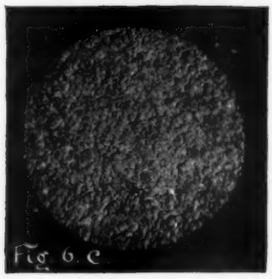


Fig. 6 C.

For this purpose, thin transverse sections of all the specimens were cut and mounted on glass slides, and a microscopical examination made.

The accompanying photographs (Figs. 1–12) show the appearance of the carbons under a magnifying power of about 40 diameters in the case of groups A, B and C, and about 80 diameters in that of D and E. While the views cannot give either the color or the lustre of the original, they are mainly useful in conveying an idea of the texture of the surface.

Examining the photographs, we note that there is a marked difference between the structure of a molded and a forced carbon. In the high tension pencil of the brand A (Fig. 1), the structure is a loose one, while the low tension rod of the same group is marked by a dense homogeneous structure; the size of the grains of carbon in the latter case is very much less than in the former, and as seen under the magnifying power of the microscope, the particles have a more metalloid lustre. Again there is probably considerable air space in Fig. 1.

Thus it appears that Fig. 1 has the qualifications of a high tension carbon, *i.e.*, looseness of structure, hence comparative softness and high resistance; and Fig. 2 the requisites of a low tension pencil, *i.e.*, density, hardness and low resistance. The resistance of the rod (Fig. 1) was measured and found equal to .199 ohm; that of Fig. 2 equaled .144 ohm. The resistance of the plated low tension carbon was .084 ohm.

The structure of the carbons in group B (Figs. 3 and 4) was found after close examination to be about the same. To secure the requisite low resistance of Fig. 4 the pencil was heavily copper-plated, the thickness of the coating being about 1–10 millimetre, while that of Fig. 3 was a little less than 1–20 millimetre.

A method different than either of those just described is used in the manufacture of carbons C (Figs. 5 and 6). As in the previous instance, molded carbons are made by this company for both high and low tension systems, but a much greater pressure is applied to the molds in manufacturing low tension pencils than in the case of high. This accounts for the difference in structure exhibited in the photographs; although a molded carbon, Fig. 6, thus approaches the structure of the forced pencil, Fig. 2.

Groups D and E are highly magnified. An attempt has been made to manufacture a carbon that will burn fairly well in either system. Fig. 8 shows this carbon. In structure it is a mean between Fig. 7 and Fig. 9. Besides a difference in pressure used in constructing pencils of group D, there is also a difference in the "mix" or composition of the carbon.

The dissimilarity in structure between carbon E, Fig. 11, and E, Fig. 12, is apparent, yet both pencils are used in high tension systems. The efficiency of these types, as well as of the others, will be discussed later. Fig. 12, it will be noted, is very similar in structure to Fig. 9 (carbon D); in both cases the striations are marked and indicate that the carbon is built up of strata lying longitudinally, or in the same direction as the application of the pressure used in manufacturing the pencils. When examined with the microscope, carbon D (Fig. 9) evinced more lustre than Fig 12, showing that a greater quantity of pure carbon was used in the manufacture of the former.

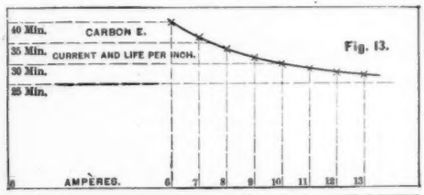


Fig. 13.

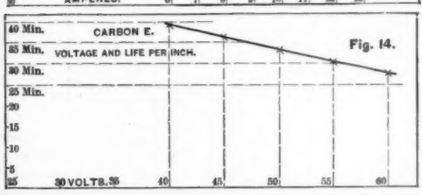


Fig. 14.

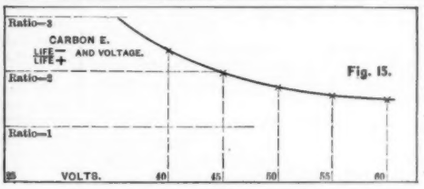


Fig. 15.

LIFE TESTS.

The high tension carbons submitted for test were designed to be burned at about 10 amperes and the low tension at about 20. In the life tests a Thomson lamp was used for high tension runs, current being kept constant at 10 amperes and P. D. at 50 volts. For low tension carbons the Weston lamp was used. The pencils were accurately weighed before and after the runs, and the life calculated on the assumption that the carbons were homogeneous. Each set of pencils were burned an hour. The results of tests are given in Table 1.

TABLE 1.

LIFE TESTS.

Carbon.	Mean Diameter, inches.	Resis. ohms.	Initial wt. + grms.	Initial wt.— grms	C. amperes.	P. D. volts.	Loss in w_t. + grms.	Loss wt.— grms.	Life 12 inch + carbon hours.
A molded high tension (naked)	.092	.199	59.97	33.10	10.	50	5.86	3.59	10.22
A forced low tension (plated)	.090	.072	64.89	37.16	21.5	50	9.13	4.43	10.03
A molded high tension (plated)	.085	.075	60.17	33.32	10.	50	4.96	3.44	12.42
B molded low tension (plated)	.085	.084	59.08	33.03	10.	50	4.90	3.44	12.42
C molded high tension (naked)	.085	.215	59.08	33.03	10.	50	4.90	3.44	12.42
C molded low tension (plated)	.085	.084	59.08	33.03	10.	50	4.90	3.44	12.42
D forced low tension (plated)	.080	.095	62.	36.10	21.5	50	6.02	3.08	9.03
D forced high or low tension (plated)	.084	.142	60.38	33.28	10.	50	6.05	4.16	9.11
D forced high tension (naked)	.087	.187	61.30	33.53	10.	50	6.46	4.29	9.14
E forced low tension (plated)	.085	.084	59.08	33.03	10.	50	4.90	3.44	12.42
E molded high tension (naked)	.085	.207	59.08	33.03	10.	50	4.90	3.44	12.42
E forced low tension (naked)	.093	.251	59.69	33.81	10.	50	5.91	3.52	10.09

It has been stated that "with carbons of the same *hardness* and length, but having different diameters, the larger will undoubtedly outlive the smaller. Of carbons of the same *diameter* and length, but differing in hardness, the harder will outlive the softer."†

This statement pre-supposes that the conductivity of the carbon is directly dependent on the hardness or softness of the pencil.

In order to examine more fully the relation between diameter resistance and mor-

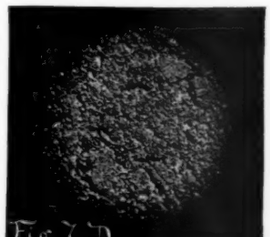


Fig. 7 D.

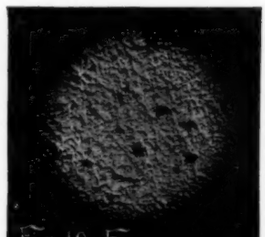


Fig. 10 E.

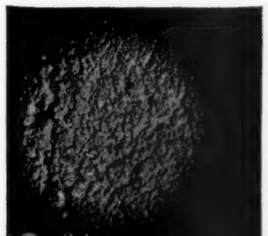


Fig. 8 D.

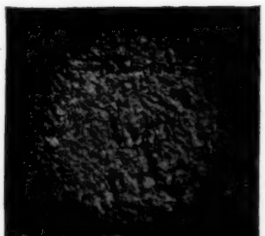


Fig. 11 E.

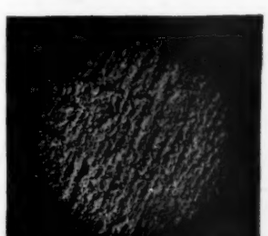


Fig. 9. D.

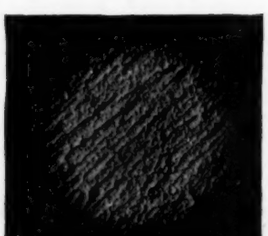


Fig. 12 E.

* G. W. Parker: Proceedings National Electric Light Association, Pittsburgh Convention, February, 1888, p. 455.

* These low tension runs were made with the Weston plant on the University Campus. Ten lamps were run in series. Time of test was 2¼ hours in the case of Carbons B and E, and 2 hours and 25 minutes in the case of C.

† G. W. Parker.

tality of a pencil, six sets of carbons of the brand B., varying in diameter from ½ to 1¼ inches, were carefully weighed, their resistances measured by the Wheatstone Bridge method and the pencils burned with a constant current of 10 amperes from a Gramme dynamo, the P.D. at the terminals of the lamp being kept at 50 volts. The diameters and resistances, respectively, of the upper and lower carbons were in each case practically the same. A mean of ten micrometer measurements of the diameter was taken as correct. The duration of each run was 60 minutes.

Following are the data:

TABLE 2.

MORTALITY WITH DIFFERENT DIAMETERS.

Carbon.	Mean diameter, inches.	Resis. ohms.	Initial wt. + grms.	Loss wt. + grms.	Life 12 inch carbon hours.
B molded high ten.	.453	.0805	44.70	4.20	10.64
" "	.505	.075	58.17	4.80	12.12
" "	.618	.0735	94.93	6.96	13.64
" "	.739	.0615	132.34	6.19	21.38
" "	.986	.061	232.20	8 88	26.15
" "	1.195	.059	339.57	10.14	33.49

From the results given in Table 2, it appears that the life of a carbon varies *directly* with its *diameter* and *inversely* with its *resistance*. This law holds only for homogeneous carbons of the same manufacture, type and structure, and, as stated before, for constant current and voltage.

Let us take the ½ inch (.505') and 1 inch (.986') pencils as standards and from the relation above stated, calculate the mortality of the other carbons.

Table 3 gives a comparison of the actual and the calculated life of the various specimens tested.

TABLE 3.

Carbon.	Mean diameter, inches.	Standard — ½" (.505') Calculated life hours.	Standard 1" (.986') Calculated life hours.	Actual life hours.
B molded light.	.453	10.99	9.32	10.64
" "	.618	15.10	13.02	13.64
" "	.730	21.58	19.44	21.38
" "	1.195	33.40	33.04	33.49

Thus it appears that the calculated life throughout the series is larger than the actual when the ½" carbon is taken as a

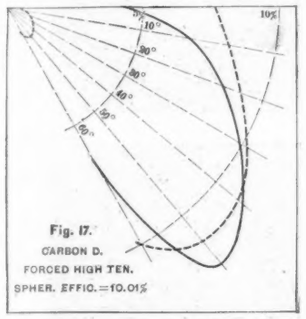


Fig. 17.
CARBON D.
FORCED HIGH TEN.
SPHER. EFFIC.=10.01%

standard and smaller when the 1" pencil is made the basis of calculation.

The carbons of group B were not perfectly round, a variation of three degrees being at times found between the ten measurements of the diameter of a pencil. In determining the resistance of the carbon rods, the tips of the latter were copper-plated when necessary and mercurial contacts used. The lamp was adjusted to burn at 50 volts potential difference for each set of pencils.

While every precaution was taken to avoid discrepancies, it is clear that from the nature of the substance experimented upon, and the extreme difficulty of maintaining constant conditions, errors are apt to creep into the work. But the results given in Table 3, as well as later determinations, undoubtedly point to the existence of such a law as has been quoted.

The relation between diameter and life having been investigated, experiments were then made to determine the curve for current and mortality of the pencil, when the voltage is kept constant.

For this purpose a number of molded high tension carbons of the brand E were used. To secure uniformity in the plus and minus pencils, a 12 inch stick was broken in half, one portion being used as the upper, the other as the lower carbon. The length of each run was an hour. Current and potential were read every two minutes and the mean taken.

Table 4 gives the data from which the curve for current and mortality (Fig. 3) was plotted.

TABLE 4.

LIFE WITH DIFFERENT CURRENTS AND CONSTANT POTENTIAL.

Carbon.	Diam. mean inches.	Resis. ohms.	Initial wt. + grms.	Initial wt. − grms.	C amperes.	P. D. volts.	Loss wt. + grms.	Loss wt. − grms.	Life per inch. Carbon burned, hours.	Life − / Life +
E molded high tension	.518	.190	90.90	91.15	6.09	49.3	4.28	2.77	.6738	1.02
" "	"	"	225.72	16.38	7.04	49.7	4.57	3.19	.6047	1.54
" "	"	"	30.58	15.19	8.01	49.9	5.48	3.35	.5662	1.60
" "	"	"	37.56	24.16	8.99	49.9	5.81	3.63	.5450	1.60
" "	"	"	81.70	50.53	10.01	49.8	6.16	3.98	.5072	1.52
" "	"	"	84.80	26.06	12.03	50.3	6.65	4.35	.4937	1.52
" "	"	"	30.58	21.72	11.00	50.2	6.67	4.18	.4910	1.60
" "	"	"	37.76	26.33	13.00	50.1	7.26	4.61	.4592	1.57

As will be seen, the range of current was from 6 to 13 amperes. The greatest variation of the mean E. M. F. for the several runs was one volt.

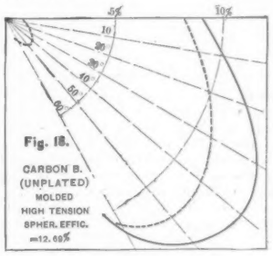


Fig. 18.
CARBON B.
(UNPLATED)
MOLDED
HIGH TENSION
SPHER. EFFIC.
=12.69%

TABLE 5.

LIFE WITH DIFFERENT POTENTIALS AND CONSTANT CURRENT.

Carbon.	Mean Diam.: Inches. +	Mean Diam.: Inches. −	Resist. ohms.	Initial wt. + grms.	Initial wt. − grms.	C amperes.	P. D. Volts.	Length run; minutes.	Loss wt. + grms.	Loss wt. − grms.	Life 1" − / Life 1" +
E molded high tension	.518	.518	.190	51.38	48.32	10.40	50	60	5.96	4.40	1.30
E molded low tension	.521	.517	.197	57.65	24.16	10.45	50	60	5.14	3.87	1.57
A molded high tension	.581	.522	.185	24.86	19.06	10.50	50	60	5.98	3.90	1.87
E forced low tension	.581	.522	.185	24.86	19.06	10.53	50	60	5.83	3.49	1.669
B molded low tension	.597	.530	.191	93.52	19.94	10.60	50	60	6.70	4.41	1.520
C molded low tension	.594	.540	.204	50.32	25.38	10.60	50	60	6.70	4.41	1.494

A series of tests was now made with constant current and varying voltage. The current in this case was maintained at 10

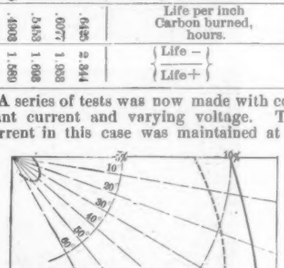


Fig. 19.
CARBON B.
(PLATED)
MOLDED
HIGH TENSION
SPHER. EFFIC.
=12.72%

amperes, and the range in tension was from 40 to 60 volts. Carbons of the same type as in the last instance were used. In Table 5 are given the figures for these runs and Fig. 14 shows the curve for voltage and mortality.

In the curves (Figs. 13 and 14) the ordinates represent the life of an inch of carbon in minutes. Reference is made not to the mortality of the plus pencil, but to the total amount of carbon burned in the lamp. The last two columns in Table 5 have been corrected for diameter and resistance of the pencil, the diameter and resistance, respectively, of the carbon that was burned at 10 amperes and 45 volts having been taken as a standard, and the life of the other pencils reduced to a common basis from this, according to the law previously stated.

Very little has been published regarding the relative life of the plus and minus carbons. Those books in which the subject is alluded to state as a rule that, with direct currents, the life of the upper carbon is about half that of the lower, provided both have the same length originally. In a recent publication * the general statement is made that "with continuous currents the plus wastes twice as fast as the minus carbon. With alternating currents the upper wastes eight per cent. faster than the lower if the carbons are vertical; but at the same rate if horizontal."

TABLE 6.

RELATIVE LIFE OF THE PLUS AND MINUS CARBONS.

Carbon.	Initial wt. + grms.	Initial wt. − grms.	C ampere.	P. D. Volts.	Length run; minutes.	Loss wt. + grms.	Loss wt. − grms.	Life 1" − / Life 1" + corrected.
B molded high tension	46.36	25.22	10	50	60	5.96	4.40	1.30
B molded low tension	61.43	31.37	10	50	60	5.14	3.87	1.57
A molded high tension	90.57	38.68	10	50	60	5.98	3.90	1.87
10 E forced low tension	244.64	324	38	50	60	5.83	3.49	1.669
10 B molded low tension	244.6	324	38	50	60	6.70	4.41	1.520
10 C molded low tension	204.50	325	38	50	60	6.70	4.41	1.494
E molded high tension	90.90	91.15	6.09	49.3	4.28	2.77	.6738	1.02
E molded low tension	225.72	16.38	7.04	49.7	4.57	3.19	.6047	1.54
A molded high tension	30.58	15.19	8.01	49.9	5.48	3.35	.5662	1.60
E forced low tension	37.56	24.16	8.99	49.9	5.81	3.63	.5450	1.60
B molded low tension	81.70	50.53	10.01	49.8	6.16	3.98	.5072	1.52
C molded low tension	84.80	26.06	12.03	50.3	6.65	4.35	.4937	1.52
10 E forced low tension	30.58	21.72	11.00	50.2	6.67	4.18	.4910	1.60
10 C molded low tension	37.76	26.33	13.00	50.1	7.26	4.61	.4592	1.57

No experiments were made upon arc light carbons fed by alternating currents, but an investigation of the relative loss of the plus and minus pencils with direct currents gave quite interesting results. Table 6 shows that the plus carbon may burn away about as fast as the minus, or may waste more than three and a half times as quickly.

Three sets of experiments were undertaken to determine the elements that affect this ratio.

1st. Effect of changing the diameter and resistance of the pencils with constant current and potential.

2d. Influence of change of current with constant potential.

3d. Change of potential with constant current.

For determining the influence of diameter and resistance upon the relative life of the plus and minus carbons, a number of molded high tension pencils of the brand A were used. The carbons were supposed to have been taken from the same "batch," and were burned with a current of 10 amperes and a P. D.—50 volts.

Examining Table 7, which gives the results of measurements, we note that $\left\{\frac{\text{life}-}{\text{life}+}\right\}$ appears to become greater with increase of diameter of the carbon. It is probable that the inequality in the diameters of the + and — pencils, respectively, as well as the difference in the resistances of the two carbons of a set, explains to a large extent the cause of this increase in the ratio. For assuming that under the conditions maintained, the life of a carbon varies directly with its diameter and inversely with its resistance, the data (Table 7) indicate that if the diameters and resistances, respectively, of the + and — carbons were the same in each run, the ratio would be practically the same for all sizes of carbons. This is brought out in the last column of the table, which gives the corrected values of $\left\{\frac{\text{life}-}{\text{life}+}\right\}$.

2d. Reference to the last column of Table 4 will show that a change in the current, other conditions remaining the same, probably has no effect on the ratio $\left\{\frac{\text{life}-}{\text{life}+}\right\}$. For when a current of 6 amperes was used, the ratio was equal to 1.62; at 7 amperes the ratio dropped to 1.54; it then alternately increased and decreased to 13 amperes. Hence, it may be said that if all errors of

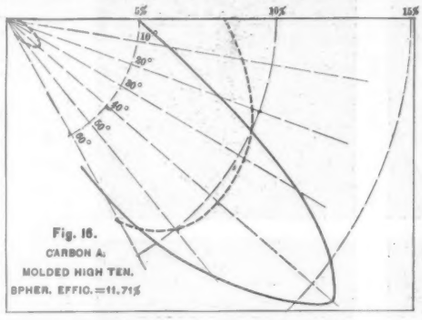


Fig. 16.
CARBON A.
MOLDED HIGH TEN.
SPHER. EFFIC.=11.71%

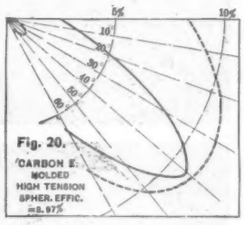


Fig. 20.
CARBON E.
MOLDED
HIGH TENSION
SPHER. EFFIC.
=13.97%

TABLE 7.

INFLUENCE OF DIAMETER AND RESISTANCE OF THE CARBON UPON THE RELATIVE LIFE OF THE + AND — PENCILS.

Carbon.	Mean diam.; Inches +	Mean diam.; Inches −	Resis. Ohms. +	Resis. Ohms. −	Initial wt. +	Initial wt. −	Loss wt. +	Loss wt. −	Life 1"− / Life 1"+	Life 1"− / Life 1"+ corrected.
A molded high ten.	.3964	.4183	.235	.241	37.91	16.97	4.96	3.04	1.63	1.79
" "	.4567	.4567	.235	.243	48.08	20.39	5.41	3.02	1.63	1.78
" "	.5018	.5153	.179	.207	50.67	25.10	5.98	3.91	1.69	1.74
" "	.5668	.5692	.178	.190	69 88	26.91	6.23	3.61	1.73	1.81
" "	.6311	.6868	.159	.140	90.57	38.68	5.98	3.90	1.69	1.79

observation, as well as those due to irregularities in the carbons, could be eliminated, the $\left\{\frac{\text{life} - \text{carbon}}{\text{life} + \text{carbon}}\right\}$ would be found to be constant.

3d. The last column of Table 5 contains the data for $\left\{\frac{\text{life}-}{\text{life}+}\right\}$ with different P. D.'s and constant current. From these calculations it appears that the ratio depends on the P. D., and that the greater the P. D., the more nearly does the former approach unity. The curve plotted from the figures in Table 5, is given in Fig. 15, the abscissæ being volts, and the ordinates representing the ratio of the life of the minus to the life of the plus carbon.

Thus the causes that influence the relative life of pencils of the same diameter, lie chiefly in the difference in the resistance of the carbons and the variations of P. D.

Judging from existing theories of the arc, it was thought that blowing the latter with a magnet during the runs would relatively increase the life of the plus carbon. The experiment was tried and the reverse was found to take place, *i. e.*, the ratio $\left\{\frac{\text{life}-}{\text{life}+}\right\}$ increased, while the life of the minus pencil was not much affected.

EFFICIENCIES.

Two methods of determining the efficiency of each set of pencils were employed. The first was the method used by Mr. Merritt in obtaining the efficiency of the incandescent lamp,* and, subsequently, by Mr. Nakano in his work on the efficiency of the arc-lamp.† The second dealt with candle-powers and will be referred to in the discussion of candle-power measurements.

It may not be amiss to give here an outline of the first method employed. A Thomson lamp was mounted on a movable frame and the rays from the burning carbons allowed to fall on the face of a thermo-pile, the latter being in circuit with a sensitive Thomson galvanometer. The deflection of

*Munro & Jamiesons' Electrical Rules and Tables, 1889.

* E. G. Merritt: Some Determinations of the Energy of the Light from Incandescent Lamps. Amer. Jour. Science. Vol. 37, p. 167.

† H. Nakano: Efficiency of the Arc Lamp. Transactions Amer. Inst. Elec. Eng. Vol. 6, p. 308.

the galvanometer was taken as a measure of the energy of the total radiation which fell upon the face of the pile. A cell containing a solution of alum was then interposed between the light and the pile, and the reduced deflection of the galvanometer noted. On the supposition that the alum cell cut off all the "dark heat" and allowed only the rays of the visible spectrum to reach the face of the thermo-pile, the last measurement would give the true value of the luminous energy emitted by the lamp. But a small percentage of the longer wave lengths passes through the alum cell, and a large part of the luminous rays is cut off by its intervention. Corrections having been made for these factors, the true values of luminous radiation resulted.

A mechanism was provided by which measurements could be made at various angles below the horizontal plane without altering the distance between the center of the arc and the thermo-pile.

For the high tension runs, the lamp was fed by a current of 9 amperes, the potential difference between its terminals being kept at 45 volts. For low tension tests, current $= 21\frac{1}{2}$ amperes, and P. D.$=30$ volts. Note that the amount of energy expended in the low tension lamp was $21\frac{1}{2} \times 30 = 645$ watts, while the high tension required but $9 \times 45 = 405$ watts. Although normally the former requires from 520 to 560 watts, unsteadiness of the light when the lamp was run below $21\frac{1}{2}$ amperes made accurate measurements impossible.

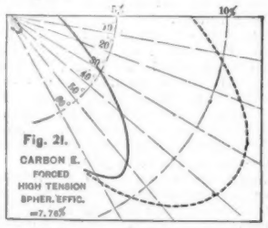


Fig. 21.
CARBON E.
FORCED
HIGH TENSION
SPHER. EFFIC.
=7.76%

Tables 8 to 15 give the results of efficiency tests. In the column headed L are given the corrected values of deflections due to luminous radiation; the values of T refer to total radiation and the efficiency or luminous divided by total radiation — $\left\{\frac{L}{T}\right\}$.

These tables furnish the data from which the curves (Figs. 16-23) were plotted. The radii show the positions for which measurements were taken, and distances measured along these lines from the origin to the *dotted* curves, give the intensity of luminous and total radiation, respectively, in each position.

It will be seen that the distribution of total radiation differs considerably from that of luminous radiation, hence the efficiency, which is expressed by $\left\{\frac{\text{luminous radiation}}{\text{total radiation}}\right\}$ depends upon the angle of measurement.

The full line curves (Figs. 16-23) represent the efficiencies of the various carbons. In order to obtain the mean or hemi-spherical efficiency, the areas of the curves of luminous and of total radiation were found by means of the planimeter; now the ratio of the radii of two semi-circles whose areas are respectively equal to those of the curves of luminous and total radiation, is the value of the mean spherical efficiency. This value has been calculated for each set of pencils and the results are given in Table 16; also in Figs. 16-23.

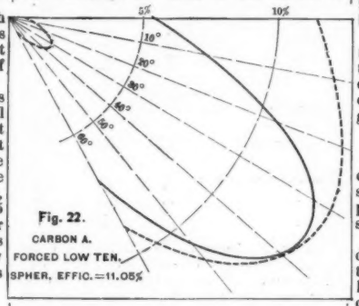


Fig. 22.
CARBON A.
FORCED LOW TEN.
SPHER. EFFIC.=11.05%

EFFICIENCY MEASUREMENTS.

TABLE 8.
CARBON A. MOLDED HIGH TENSION.

Angle Deg.	L	T	L/T
0	6.085	110	.0553
10	8.112	130	.0624
20	11.49	134	.0858
30	16.90	146	.1158
40	23.67	146	.1621
50	15.55	143	.1087
60	10.14	125	.0811

TABLE 9.
CARBON D. FORCED HIGH TENSION.

Angle Deg.	L	T	L/T
0	4.733	107	.0442
10	8.133	118	.0688
20	11.49	129	.0892
30	14.20	142	.0977
40	16.91	152	.1112
50	19.61	156	.1257
60	8.790	142	.0619

TABLE 10.
CARBON B. UNPLATED MOLDED HIGH TENSION.

Angle Deg.	L	T	L/T
0	10.14	114	.0889
10	13.52	127	.1065
20	15.55	144	.1080
30	18.26	157	.1163
40	22.31	165	.1352
50	22.31	163	.1352
60	15.55	156	.0995

TABLE 11.
CARBON B. PLATED MOLDED HIGH TENSION.

Angle Deg.	L	T	L/T
0	11.49	116	.0991
10	14.21	128	.1057
20	15.55	145	.1072
30	19.60	157	.1248
40	22.31	164	.1361
50	18.58	164	.1360
60	15.55	141	.1108

TABLE 12.
CARBON E. MOLDED HIGH TENSION.

Angle Deg.	L	T	L/T
0	2.702	116	.0233
10	5.405	134	.0403
20	8.108	146	.0555
30	13.51	157	.0861
40	17.57	159	.1105
50	11.48	145	.0792
60	7.77	112	.0710

TABLE 13.
CARBON E. FORCED HIGH TENSION.

Angle Deg.	L	T	L/T
0	2.702	118.5	.0228
10	4.054	131.0	.0310
20	6.756	158.	.0428
30	6.081		.0483
40	10.13	175.0	.0579
50	14.19	155.0	.0895
60	11.48	136.0	.0844

TABLE 14.
CARBON A. FORCED LOW TENSION.

Angle Deg.	L	T	L/T
0	8.784	162	.0542
10	12.16	170	.0715
20	20.27	185	.1095
30	25.68	190	.1351
40	25.68	190	.1351
50	16.89	167	.1089
60	9.459	130	.0728

TABLE 15.
CARBON B. MOLDED LOW TENSION.

Angle Deg.	L	T	L/T
0	10.81	190	.0569
10	17.57	211	.0833
20	25.68	223	.1151
30	28.38	223	.1273
40	17.57	215	.0817
50	12.83	189	.0678
60	6.081	135	.0451

TABLE 16.
EFFICIENCY MEASUREMENTS.

Carbon.	Diam. mean inches.	Resis. ohms.	C amp.	P. D. volts.	Horizontal efficiency.	Maximum efficiency.	Hemi-spherical efficiency.	Life 12 inch + carbon hours. C. / P. D.
A molded high tension	.506	.203	9	45	.0253	.1021	.1171	10.22@10 -50- -50-
D forced high tension	.457	.187	9	45	.0242	.1257	.1091	8.64@10 -50- -50-
B molded (unplated) high tension	.453	.224	9	45	.0269	.1352	.1260	9.16@10 -50- -50-
B molded (plated) high tension	.438	.0805	9	45	.0091	.1369	.1272	10.64@10 -50- -50-
E molded high tension	.533	.302	9	45	.0223	.1105	.0896	10.30@10 -50- -50-
E forced high tension	.522	.281	9	45	.0228	.0896	.0776	10.00@10 -50- -50-
A forced low tension	500	.072	21.5	30	.0548	.1351	.1105	10.35@11@-50-
B molded low tension	496	.071	21.5	30	.0569	.1872	.0902	9.40@@-50-

We notice that the horizontal efficiency is very small compared with the maximum; that relatively high efficiency in a *forced high tension* carbon is obtained only at the expense of life; that a *molded* carbon is, generally speaking, superior to a *forced* for high tension and *vice versa* for low tension.

In the case of the high tension carbons B and D, the diameters are smaller than those of the other pencils, hence we are to expect a relatively higher efficiency since as was shown last year, the "efficiency varies inversely as the diameter."*

A point of interest brought out by these tests (Tables 10 and 11 and Figs. 18 and 19) is the fact that while the life of a copper-plated carbon is greater than that of an unplated carbon of the same diameter and type, the mean spherical efficiency appears to be the same for both.

*H. Nakano.

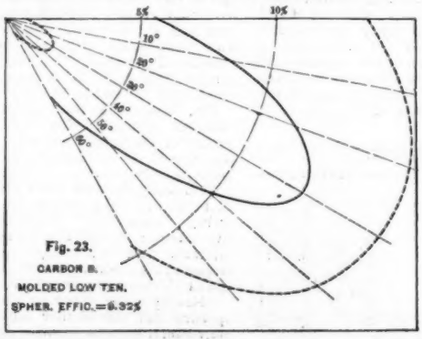


Fig. 23.
CARBON B.
MOLDED LOW TEN.
SPHER. EFFIC.=6.92%

Two sets of pencils of the brand B, the one unplated and the other plated, were burned to ascertain this relation. The results show that the horizontal and the maximum efficiency of the copper-plated carbons were a little greater than those of the uncoated pencils, respectively, and the mean spherical efficiency in the latter case was very slightly less than in the former. As can be seen from Table 16, the life of the "positive" plated pencil (12" long) was 10.64 hours, while that of the naked carbon was 9.16 hours, the current and P. D. having been the same for both cases.

No positive explanation of this phenomenon has yet been given but it appears that the actual amount of *combustion* in both cases is the same, while the *disintegration* caused by the passage of the current is greater in the case of the unplated carbon.

CANDLE-POWER MEASUREMENTS.

The candle-power measurements consisted chiefly in the determination of the hemi-spherical candle-power of the different pencils and from this quantity the watts per spherical candle-power produced.

The runs were made under the same conditions as in the efficiency tests. For high tension carbons current — 9 amperesand P. D. — 45 volts. For low tension pencils, current — 21.5 amperes and P. D. — 30 volts.

To ascertain the candle-powers, the method of the Franklin Institute Committee was used.* The photometric apparatus was somewhat different in detail from that ordinarily used in measuring the candle-power of incandescent lamps and deserves a brief description.

The arc lamp was suspended from an arm which could be rotated about an axis parallel to the photometer bar and vertically above it. By manipulating a rope connected with the arm, the latter could be raised until it was at right angles with the photometer bar, or lowered until it was horizontal. The arm being horizontal, the lamp was hung from its extremity so that the arc was on a level with the center of the photometer disk. It will be seen that when the arm was pulled up, the arc described a vertical circle, the axis of which was a line parallel to the photometer bar and passing through the center of the disk. The center of the vertical circle was at the point (800) of a scale graduated into (1,000) divisions, and the radius equal to the length of (200) scale divisions.

At the zero of the scale was placed a Weston incandescent lamp, and a circular mirror of silvered glass, the axis of which was horizontal and inclined 45° to the reflecting surface, was mounted on the bar so that its center coincided exactly with the 800th division of the scale. Thus the distance between the arc lamp and the mirror was rendered constant for all elevations of the former, and when the mirror reflected the light of the lamp upon the disk, the angles of incidence and reflection were always equal to 45°. The virtual image of the arc under these circumstances was at the 1000th division of the scale. The Weston lamp was used as a secondary standard and maintained by a storage battery throughout the runs at 115 volts; its candle-power was ascertained before and after the tests by comparing it with a standard Methven "Board of Trade" two candle-power slit.

Photometer readings were made, as in the case of the efficiency tests, at 0° and at 10° 20°, 30°, 40°, 50° and 60°, below the horizontal, the mean of 20 observations being taken for each elevation. These measurements were multiplied by the candle-power of the secondary standard and corrected for absorption of light by the mirror.

Tables 17-23 give the corrected data, which form the basis of the candle-power curves (Figs. 24 and 25). Distances measured along the radii from the origin to each curve, give the candle-power for the various angles. The mean spherical candle-power for any case is measured by the radius of a semi-circle whose arc is equal to the area of the candle-power curve.

*Reports International Electrical Exhibition of Franklin Inst., 1884. Group B, Sections 5 and 8.

CANDLE-POWER MEASUREMENTS.

TABLE 17.
CARBON A; MOLDED HIGH TENSION.

Angle. Deg.	Candle-power.
0	221.3
10	474.1
20	713.1
30	979.2
40	1033.0
50	986.6
60	370.7

TABLE 18.
CARBON B; MOLDED HIGH TENSION.

Angle. Deg.	Candle-power.
0	382.9
10	684.4
20	908.4
30	1118.
40	1131.
50	749.3
60	570.8

TABLE 19.
CARBON D; FORCED HIGH TENSION.

Angle. Deg.	Candle-power.
0	210.5
10	407.4
20	687.4
30	977.1
40	1079.0
50	1140.
60	599.7

TABLE 20.
CARBON E; MOLDED HIGH TENSION.

Angle. Deg.	Candle-power.
0	227.3
10	286.8
20	439.9
30	722.2
40	987.2
50	1080.0
60	414.0

TABLE 21.
CARBON E; FORCED HIGH TENSION.

Angle. Deg.	Candle-power.
0	221.7
10	328.
20	350.1
30	558.0
40	636.3
50	630.7
60	265.5

TABLE 22.
CARBON A; FORCED LOW TENSION.

Angle. Deg.	Candle-power.
0	393.7
10	712.1
20	866.9
30	1094.
40	1183.
50	683.2
60	405.4

TABLE 23.
CARBON B; MOLDED LOW TENSION.

Angle. Deg.	Candle-power.
0	475.4
10	593.7
20	720.9
30	871.3
40	866.6
50	528.4
60	354.8

Although great care was taken in ascertaining the candle-powers, the difference in color between the light emitted by the arc and that given by the standard was so marked that the setting of the photometer carriage was to a large extent a matter of personal judgment; hence the measurements given cannot be considered as absolute, but rather as relative values.

The conclusions drawn from the efficiency curves hold generally, as will be seen by an examination of Table 24, for the candle-power curves. From the latter it appears that the efficiency of low tension carbons, and especially of *molded* low tension pencils, is comparatively small. While the efficiencies of molded high tension carbons are as high as .953 and .888 watts per spherical candle, or 788 and 840 candles per electrical horse-power expended in the lamp, the efficiencies of low tension pencils of nearly the same diameter as the high are as small as 1.255 and 1.612 watts per candle, or 594 and 502 candles per electrical horse-power.

This fact is not brought out in Table 16, for reference to the latter shows the low ten-

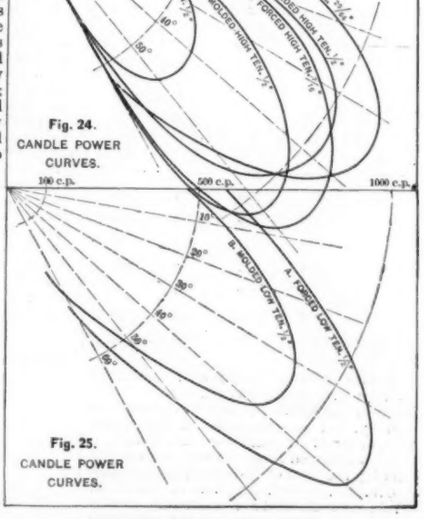


Fig. 24.
CANDLE POWER
CURVES.

Fig. 25.
CANDLE POWER
CURVES.

sion pencils to have a rather high efficiency, and in some cases considerably higher than the high tension carbons. However, when the energy expended in the lamp in the two cases, respectively, is taken into account, the explanation of the high values for carbons A and B (Table 16, low tension) is apparent.

TABLE 24.

CANDLE-POWER MEASUREMENTS.

Carbons.	Diameter (mean) inches.	Resis. ohms.	C. amp.	P. D. volts.	Horizontal candle-power.	Maximum candle-power.	Hemi-spherical candle-power.	Watts per spherical c. p.	Spherical c. p. per Elec. horse-power.
A molded high tension	.098	.203	0	45	221	1093	450	.966	940
D. forced high tension	.457	.187	0	45	210	1140	486	.933	966
B unplated molded high tension	.433	.224	0	45	388	1131	525	.774	967
E molded high tension	.533	.202	0	45	257	1080	425	.953	788
E forced high tension	.522	.351	0	45	222	936	388	1.407	581
A forced low tension	.500	.072	21.5	30	594	1136	514	1.263	594
B molded low tension	.498	.071	21.5	30	475	871	400	1.613	562

Carbon B (molded high tension, Table 24), it will be noted, has the highest efficiency of the group. This is due largely to the fact that its diameter is smaller than that of any of the others, for "the candle-power varies inversely as the diameter."*

Similarly the relatively high candle-power of carbon D is accounted for by the small diameter of the pencil. In Table 24 and the candle-power curves, we again note the comparatively small efficiency of *forced* high tension carbons.

The efficiency of carbon A (molded high tension, Table 16), as measured by $\left\{\frac{\text{luminous radiation}}{\text{total radiation}}\right\}$, is larger than that of carbon D; yet the mean spherical candle-power of the latter is greater than that of the former (Table 24). The explanation of this phenomenon (assuming the measurements to be correct) probably lies in the difference in the *quality* of the light emitted.†

In some instances it is desirable to ascertain the mean spherical candle-power of a lamp approximately, without taking the time to integrate the curve.

The formula given by M. Gerard, namely, "spherical c. p. = ⅙ horizontal c. p. + ¼ maximum c. p."‡ is of sufficient exactitude for practical purposes. Gerard gives the following table showing the observed and calculated spherical candle-powers for seven lamps.

TABLE 25.

GERARD'S MEASUREMENTS OF CANDLE-POWER.

Lamps.	Horizontal c. p.	Maximum c. p.	Spherical c. p. calculated.	Spherical c. p. observed.
No. 1	250	1464	491	470
" 2	456	3250	1040	1145
" 3	560	3071	1048	1221
" 4	744	1227	679	692
" 5	122	840	271	274
" 6	586	2100	818	802
" 7	935	1150	755	767

Taking the whole number of lamps, the average error is only five per cent. "The angle or maximum intensity was about 45° usually, but in some cases it approached that of 30° or 60° from the horizontal."

Data collected from various sources, including the tests of the Franklin Institute Committee, in 1884, are given in Table 26. From the horizontal and maximum candle-powers, the mean spherical was calculated by Gerard's law. Comparison with the observed candle-powers shows that in some cases the error is less than one per cent. The mean error is, however, larger than that obtained by Gerard, and reaches about 9¾ per cent. Hence, as was stated before, the law is valueless except in cases of rough approximation.

TABLE 26.

CANDLE-POWER CALCULATIONS, USING GERARD'S LAW.

Lamps.	Horizontal c. p.	Maximum c. p.	Spherical c. p. observed.	Spherical c. p. Calculated	Authority.
Weston	344	609	348	324	B. W. Snow.
"	290	570	295	293	" "
"	313	609	309	304	" "
Brush	380	584	349	349	" "
"	516	1205	640	567	" "
"	813	1305	609	594	" "
Ball (1200 c. p.)	380	1360	349	349	" "
Brush (1200 c. p.)	451	1377	574	569	" "
Van Depoele (35 light)	833	1155	470	455	" "
Van Depoele (60 light)	380	1360	633	594	" "
Western Elec.	269	355	186	320	Prof. W. A. Anthony.
Thomson-Houston	267	1060	495	383	" "
"	222	936	388	367	" "
Weston	475	871	490	496	L. B. Marks.
"	594	1136	514	504	" "
"	562	1136	514	504	" "

Reference has been made to the fact that while the curve for luminous radiation is similar to that of candle-power, the curve for total radiation differs widely from the latter. As the efficiency depends upon the ratio $\left\{\frac{\text{luminous radiation}}{\text{total radiation}}\right\}$, it is plain that Gerard's law will not hold for calculating the mean spherical efficiency from the horizontal and the maximum. But again, for approximations a similar law holds, *i. e.*,

Spherical efficiency = ⅓ *horizontal* + ⅔ *max.*

Although the topic of efficiencies has been discussed in another part of the article, it may not be out of place to add a few words here, bearing upon the law in question. Measurements of horizontal, maximum and mean spherical efficiency, made by Mr. H. Nakano and by the writer, are given in Table 27, and the last law mentioned applied in the calculation of the spherical efficiency. In some cases the error is exceedingly small while in others it is comparatively large; the mean error of 14 tests is not quite eight per cent.

TABLE 27.

OBSERVED AND CALCULATED EFFICIENCIES.

Carbon.	Horizon. Efficiency. per cent.	Max. Efficiency. per cent.	Spherical Efficiency observed, per cent.	Spherical Efficiency calculated, per cent.
.832 inch	1 82	9.00	6.87	5.60
.563 "	4.12	14.41	11.00	11.33
.500 "	4.91	17.33	12.66	14.22
.450 "	5.48	15.52	13.30	13.01
.370 "	5.55	17.50	15.54	14.51
.250 "	8.44	19.80	16.60	16.96
A molded high tension	5.53	16.21	11.71	13.53
D forced "	4.42	12.37	10.01	10.53
B (unplated) "	6.89	13.53	12.69	12.37
B (plated) "	9.91	13.69	12.72	12.75
E molded "	2.33	11.05	8.96	8.87
E forced "	2.98	8.95	7.76	7.29
A forced low tension	5.42	13.51	11.05	12.68
B molded "	5.69	12.73	9.32	10.96

OBSERVATIONS OF THE ARC AND THE CARBON POINTS.

With a given potential difference between the terminals of the lamp, the length of the arc depends upon the current flowing, and increased as the current becomes greater. If the current be kept constant, the length of the arc increases with the P. D.

Data given in Tables 28 and 29 show the length of the arc for both cases.

TABLE 28.

LENGTH OF ARC, CONSTANT POTENTIAL.

Carbon.	Current amp.	P. D. volts.	Length of arc; in.
E molded high tension	6	50	.087
" "	7	50	.114
" "	8	50	.137
" "	9	50	.147
" "	10	50	.150
" "	11	50	.154
" "	12	50	.156
" "	13	50	.167

TABLE 29.

LENGTH OF ARC: CONSTANT CURRENT.

Carbon.	Current amp.	P. D. volts.	Length of arc; in.
E molded high tension	10	40	.073
" "	10	45	.095
" "	10	50	.141
" "	10	55	.186
" "	10	60	.216

In order to measure the length of the arc a lens was so mounted as to throw the magnified image of the former upon a surface carrying a vertical scale. Then after measuring the distance between the magnified points and applying the proper reduction factor, an additive correction was made for the depth of the crater, thus giving the length of arc from the tip of the minus pencil to the point directly above in the center of the crater of the plus.

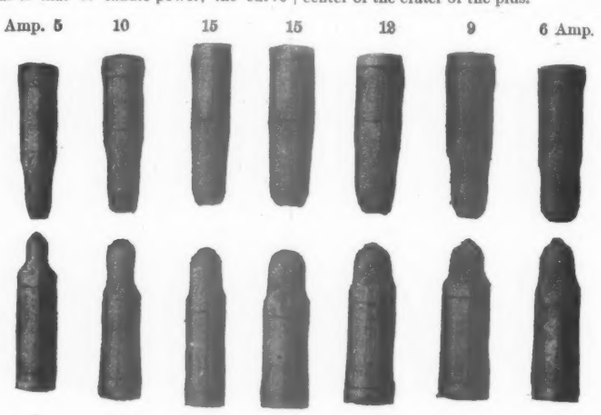


FIG. 26.

Form of the Carbon Points: Constant Potential—50 volts.

From the figures (Tables 28 and 29), it seems that no direct relationship exists between the length of the arc and the current and P. D. In the case of carbons tested, the length of the arc with constant potential increased very rapidly as the current was changed from six to nine amperes, and then gained slowly from 9 to 13 amperes. The nature of the change was somewhat different in the constant current runs, the length of the arc increasing more nearly as the square of the voltage.

After each of the runs noted in Tables 28 and 29, the carbon points were examined, and it was found that the latter assumed particular shapes depending upon the current and P. D. used. Another series of tests were made with carbons C and E (molded high tension), in which the current ranged from 5 to 15 amperes, the P. D. being kept constant at 50 volts.

Fig. 26 shows the form of the points with different currents. Nos. 1, 2 and 3 are pencils of the brand C, and 4, 5, 6 and 7 of the type E. The photographs of the carbons are three-quarters of the actual size.

Examining the first three pencils, we see that with five amperes there is a tendency to form a "mushroom" on the lower or negative carbon; the latter is eaten away considerably just below the tip. With 10 amperes this tendency is not at all marked, and at 15 almost inappreciable.

Glancing at the upper or plus carbons, it appears that the smaller the current, the more nearly does the positive pencil burn to a point, that is, the smaller the diameter of the crater. But though the width of the crater is less in the case of low currents than with high, the depth of the former is correspondingly greater. The photographs do not bring out this point, but an inspection of the tip of the lower carbon gives a clue to the facts. Note that with small currents the negative electrode terminates in a pointed, sometimes globular projection. As has been stated before, this tip becomes less noticeable with increase of current, a fact which is brought out by inspecting Nos. 7, 6, 5 and 4 (Fig. 26). In No. 4, burned at 15 amperes, the end of the lower carbon is blunted; the depth of the crater in the upper was practically zero. In Nos. 5, 6 and 7, burned at 12, 9 and 6 amperes, respectively, the depth of the crater increases as the current diminishes.

With high currents, the carbon is disintegrated to a greater distance above the point than with low.

Fig. 27 shows the form of the carbon points when the latter are burned with constant current — 10 amperes. The range in P. D. was from 40 to 60 volts.

Just as the peculiar burning of the tip distinguishes a pencil fed by a low from one burned at a high current, so the form of the carbon point differs in the case of a pencil burned with low voltage than with high. In Nos. 1, 2, 3, 4 and 5, Fig. 27, the gradual change in the formation, from a sharp projection at 40 volts to a blunt end at 60 volts, is noticeable.

The "mushroom" which invariably forms in carbons burned at a low current and high voltage, is absent when the pencils are burned at high current and low voltage.* In the former instance, the thin neck of the "mushroom" often breaks, thus arresting the current and extinguishing the arc. In the latter case, the end of the carbon is prone to so burn away as to leave a concave outline. (See No. 1, Fig. 27.)

At 40 volts the depth of the crater measured .051 inch. At 60 volts the crater disappeared; the carbons also "flamed" at this high voltage.

With a given current there is for every brand of carbon a certain voltage, above which, if the pencil be burned, "flaming" will result. A simple trial is sufficient to determine this critical point.† Again there is a voltage, below which, if the carbon be burned, "hissing" takes place. With perfectly centered carbons there is no difficulty in ascertaining the latter point.

Careful observation of the arc shows that when the tension is too high for a given carbon, the walls of the crater break away, allowing the arc to play on the outside surface of the carbon. This action is always accompanied by a flame, which shoots from the negative carbon. On placing the negative pencil above and the positive below, the flame shoots down. With soft cored carbons, well centered, one cause of flaming—namely, liability of the arc to play laterally—is obviated; and if the pencils be burned with the proper current and voltage, there seems to be no reason why this disagreeable feature of the arc lamp should not be entirely overcome.

There is not so much liability to "hiss" in a high tension system as in a low, for from the formation of the carbon points when the pencils are burned in commercial low tension lamps, it appears that the minus carbon terminates in a small mushroom button. The breaking of this pellicle of carbon and the consequent action of the lamp mechanism to reduce the rise in potential due to the rupture, invariably result in the "hissing" of the arc.

Most of the irregularities in the action of arc lamps probably result more from the unsuitableness of the carbon than from defects in the lamp mechanism or changes in the strength of the current and P. D. in the line.

The remedy lies with the carbon manufacturer. A careful study of the relation between the microscopical structure of the pencil and the action of the latter in a given case would be likely to bear fruitful results. Of course the field for experimentation is large, but the improvements which must necessarily follow conscientious records will undoubtedly be of great scientific as well as commercial value.

In the present state of the art of carbon manufacture, it is the central station manager who must exercise great discrimination in the selection or arc light pencils for his plant. Mr. E. F. Peck has recently shown how a "comparative test of the best known carbons in the market," resulted in "a saving of 64.73 electrical horse-power in a station burning a thousand arc lamps."‡

But there is no reason why the carbon manufacturer, given the condition of a lighting system as regards current, tension required, light and life of pencils, etc., should not be able to produce a carbon specially adapted to the needs of that system.

When the root of existing defects is thus struck at, the solution of the arc light carbon problem will be at hand.

The experiments published in this paper were made under the direction of Professor Edward L. Nichols, in the laboratory of Cornell University. The writer is indebted to Mr. A. B. Levy, R. G., for valuable assistance in the work.

* M. Schreihage: Centralblatt für Elektrotechnik, No. 22, 1888.

†The reader is referred in this connection to, "A Spectrophotometric Comparisonof Artificial Sources of Illumination." Paper by Edward L. Nichols and W. S. Franklin, read before A. A. A. S., at Cleveland, August, 1888.

‡M. Gérard: Candle-power of Arc Lamps:—Centralblatt für Electrotechnik, also N. Y. Elec. World, Jan. 25th, 1890.

*When the carbon is impure and contains a large amount of silica, the latter is often deposited in the form of a glass bead on the point of the negative pencil. The "mushroom" alluded to in the text does not refer to this deposition.

†O. G. Pritchard: Electric Arc Light Carbons. London Elec., Mar. 21st and Apr. 4th, 1890.

‡E. F. Peck of Brooklyn, N. Y.: Carbon Tests. Paper read before National Electric Light Association, Kansas City Convention, February, 1890.

KINDRED INTERESTS

The Ball Engine Company, of Erie, Pa., recently shipped the North Western Guarantee Loan Company, of Minneapolis, Minn., two 100 horse power engines for electric lighting for the beautiful block now being built by that company.

The Star Iron Tower Company, of Fort Wayne, Ind., are in the field with the 1890 edition of their American Electrical Directory. The book is now in press, and will be issued very shortly. This is a work deserving of the patronage of every member of the electrical fraternity. The company publishing the directory are always grateful for any information or correction of errors in previous editions, which may be pointed out to them. The publication is a representative and comprehensive directory.

The American Electrical Works, Providence, have removed their New York office to the first floor of the building No. 10 Cortlandt street. Mr. Ackerman, the general agent, is gradually getting things in shape. The front part of the floor facing on Cortlandt street, is fitted up as a general office, while a large space back of this is devoted to a salesroom. Still further back is a handsome little private office, and beyond this is a store and supply room. Combination fixtures will illuminate the offices, and the new coat of paint on the walls will aid in reflecting the light. It is a cosy suite of offices.

Hazazer & Stanley, electrical house furnishings, now occupy two entire floors of the building at 32 and 34 Frankfort street, this city. The upper floor is used as a shop, while the lower is fitted up as offices and warerooms. A new bell, which is meeting with a large sale, has recently been brought out by this firm. A novel feature is that the armature, rod and hammer of the bell are combined in one solid piece. Over 4,000 of these bells were made last month. The work of making these is so arranged in the shop that in the process of manufacture a bell passes clear around the room, and is finally packed for shipment at the starting point. The recent addition of the upper floor just doubles the capacity of the shops.

The National Electrical Manufacturing Company, successors to the electrical department of the New Haven Clock Company, have secured the entire second floor of the building at 14 and 16 Vesey street, N. Y. Handsome and particularly convenient offices are being fitted up. The company is moving in and will open for business at the new location during this week. Mr. J. G. Noyes, who was the successful manager of the electrical department of the New Haven Company, will have the management of the new company. This company has procured a large factory at Milford, Conn., 40x280 feet, facing the New Haven R. R. It is the intention of the company to move into the new factory about June 1st, and to place in it all of the electrical machinery acquired from the New Haven Clock Company, and also to add considerable improved machinery.

Queen & Company, Philadelphia, have the reputation with some, of being rather slow and conservative, but it is interesting to notice that Queen & Company, the well known makers of electrical test instruments, have apparently outgrown their surroundings and are building up a great business in their line. Until within the last two or three years practically all the measuring apparatus used in this country was imported from abroad, a popular feeling existing that the value of an instrument was enhanced if a foreign name appeared on it. Queen & Company have demonstrated that they can make electrical test instruments at least equal in quality to the best of foreign makers and as reasonable in price. They are finding customers for their standard resistance boxes, portable testing sets, ammeters and voltmeters and their other specialties in all parts of the United States, and have even had inquiries from abroad. They report a recent large sale to the Northwest, comprising Ayrton & Perry instruments, portable testing sets, Cardew voltmeters, tachometers, etc., to the amount of about $1,500,000.

FIG. 27.

Form of the Carbon Points: Constant Current—10 Amperes.

The Thomson-Houston Motor Company, Boston, have had printed an interesting booklet describing their motor. The construction is taken up in detail, and every point of interest to the intending purchaser is fully treated. Aside from its value to prospective users of electric power, the information contained in the little book is valuable to the general reader.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MAY 20, 1890.

428,066 Arc lamp; Chas. P. Bruse, New York, N. Y.
428,071 Insulator for electric railway wires. 428,072 Trolley system for electric railways; Harold P. Brown, New York, N. Y.
428,073 Commutator brush for dynamos; Lewis Van Brown, Asheville, N. C., assignor of one-half to Wm. H. Inloes, same place.
428,084 Electric meter; Alphonse Frazer, Paris, France.
428,087 Process of electro-deposition; Davis Garnett, Kansas City, Kans., assignor of one-half to James Clark, same place.
428,095 Electric signal circuit; Orlando W. Hart, Fall River, Mass.
428,098 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Company, Boston, Mass.
428,114 Welding compound; Arthur D. Le Roy and Chas. A. Lowell, Cortland, N. Y.
428,116 Galvanic battery; Archibald J. McDonald, North Tiverton, R. I., assignor to Henry E. Townsend, trustee, Boston, Mass.
428,136 Trolley arm support for electric railways; Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place.
428,145 Elevated conduit for electric wires; Henry N. Ruttan, Winnipeg, Manitoba, Canada.
428,169 Electric motor regulator; Walter H. Knight, New York, N. Y.
428,174 Telephone; John C. Ludwig, San Francisco, Cal., assignor of one-half to A. C. Paulsell and Martin Corcoran, same place, and T. C. Coogan and H. T. Compton, Oakland, Cal.
428,175 Electric locomotive; James F. McLaughlin, Philadelphia, Pa.
428,189 Three-wire multiple switchboard system; Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place.
428,201 Machine for covering wire; Frank E. Davis, Boston, and John Scott, Jr., Plymouth, Mass.
428,210 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut.
428,211 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Company, Boston, Mass.
428,221 428,224 428,225 428,226 Synchronous multiplex telegraphy. 428,222 428,223 Multiplex telegraphy; Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Church, N. J.
428,273 Graphophone; Mark L. Deering, Cleveland, Ohio.
428,280 Electric meter; Jacob F. Mehren, Chicago, Ill., assignor to the American Electric Meter Company, same place.
428,289 Armature for dynamos, etc.; Albert Schmid, Allegheny, assignor to the Westinghouse Electric Company, Pittsburgh, Pa.
428,290 Electric meter; Ernst W. von Siemens, Berlin, Germany.
428,317 Regulator for electric current generators; Gustav Pfannkuche, Cleveland, Ohio.
428,358 Cut-out; Nathan P. Stevens, Concord, N. H.
428,378 Electric furnace for melting metals. 428,379 Electric induction device; Edw. A. Colby, New Haven, Conn.
428,380 Dynamo electric machine or electric motor; Edgar Croasdale, Philadelphia, Pa.
428,401 Device for elevating and lowering electric lamps; John B. Morris and Geo. Voll, Cincinnati, Ohio, said Voll assignor to said Morris.
428,427 Registering attachment for telephones; Robt. J. Stovey, John T. Stovey, Albert E. Fox and Geo. J. Hill, Buffalo, N. Y., assignors of one-fifth to Geo. F. Fox, Jr., same place.
428,453 Electric gas lighter; Robt. T. Walton, Philadelphia, Pa.
428,435 Alternating current arc lamp; Geo. Westinghouse, Jr., Pittsburgh, Pa.
428,443 Electrical heater; John I. Ashbaugh, Chattanooga, Tenn.

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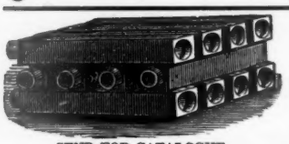

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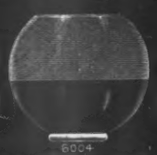
GLOBES  **SHADES**
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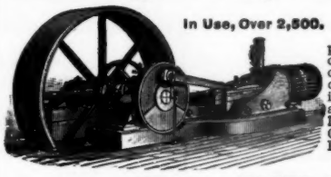

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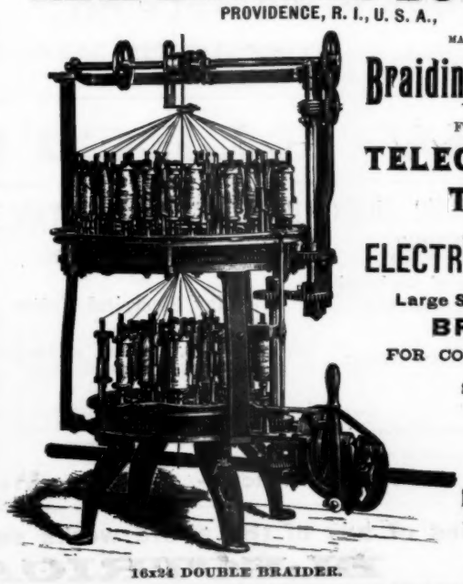

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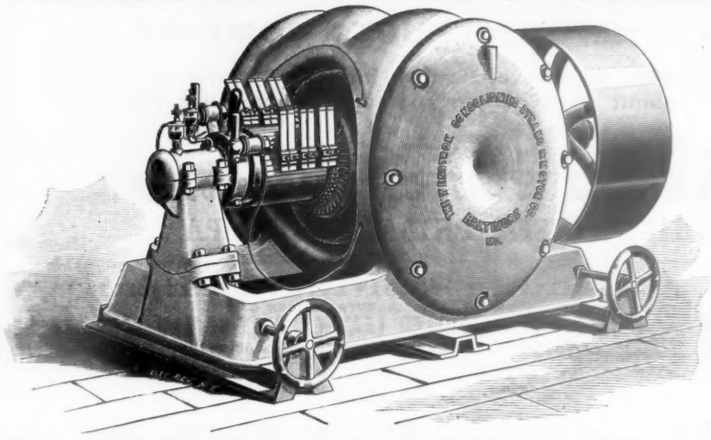

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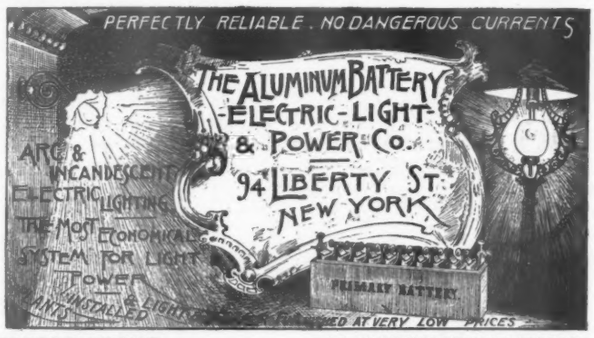

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C	.....	10	.....	.....	6.3	1½		580
C	.....	.....	.....	25	8.0	2		580
D	16	.....	.....	.....	12.0	2½		780
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G	.....	.....	45	.....	21.0	4		1,360
G	.....	.....	.....	70	21.0	4½		1,360
H	40	.....	.....	.....	29.7	6		1,750
H	.....	50	.....	.....	30.0	6		1,750
H	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
I	.....	65	.....	.....	38.6	8		2,290
I	.....	.....	83	.....	38.0	8		2,290
K	64	.....	.....	.....	46.5	10		2,770
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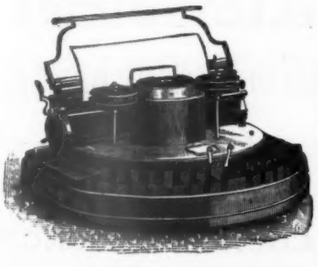

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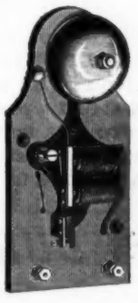

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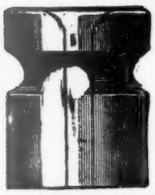

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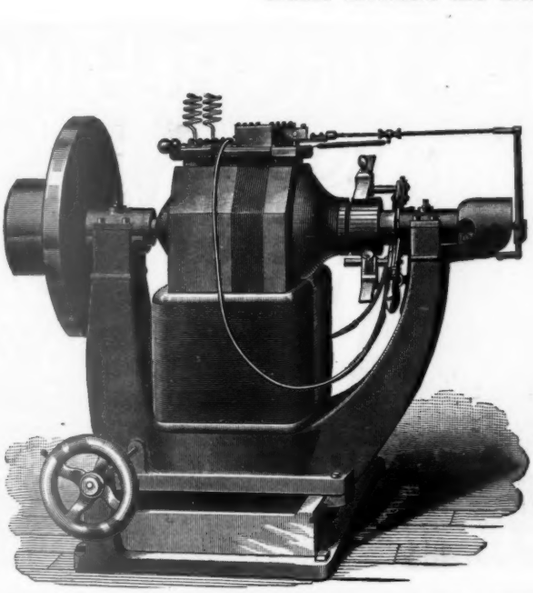

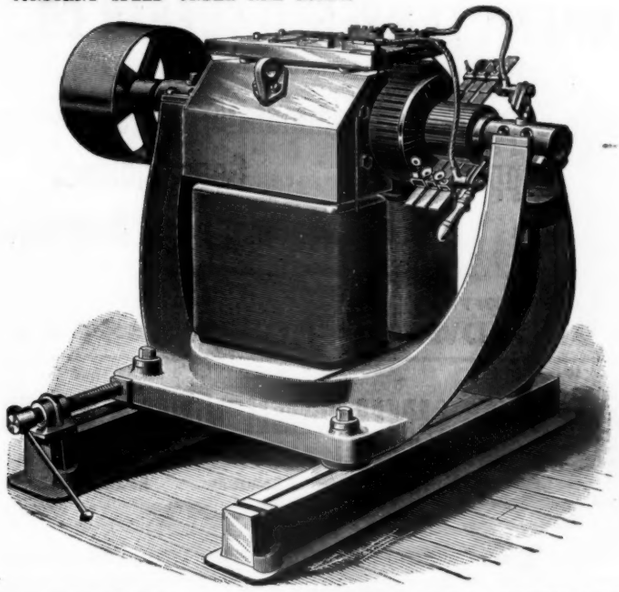

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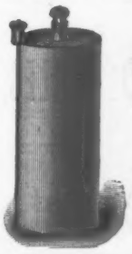

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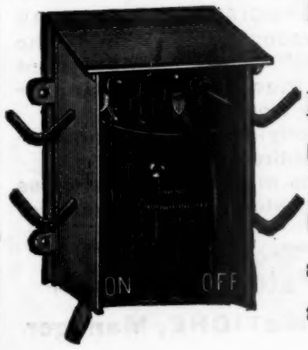

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FIG. 1.

Fig. 1 represents Copper Tee used for branching from main cables, as shown in Fig. 2.

FIG. 2.

Fig. 3 represents a Copper Sleeve used for straight connections for continuation of cables.

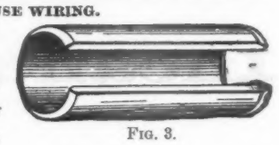

FIG. 3.

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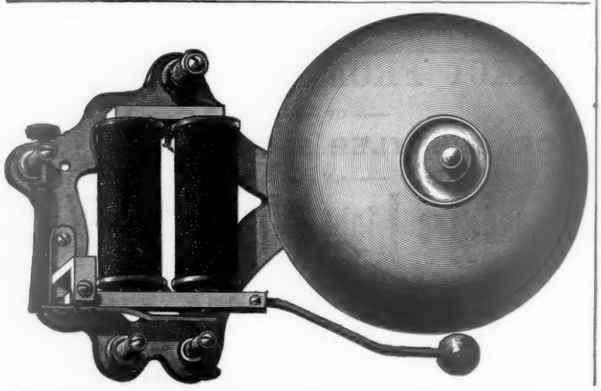

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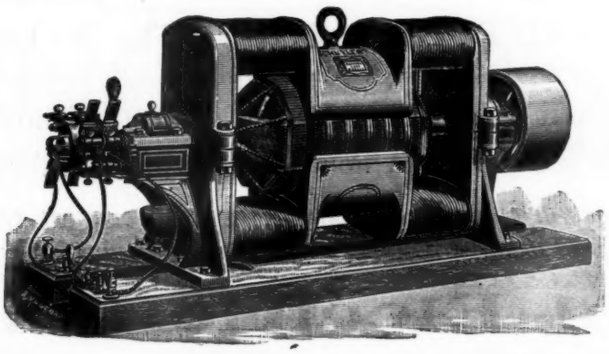

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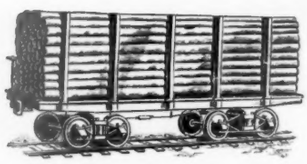

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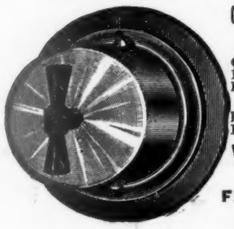

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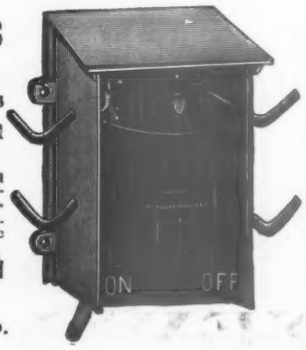

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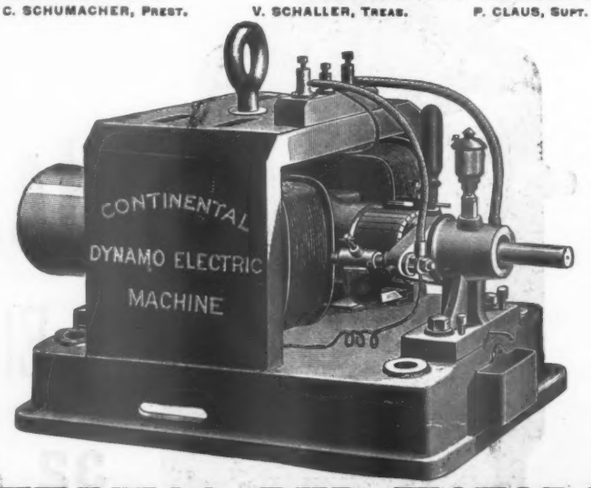

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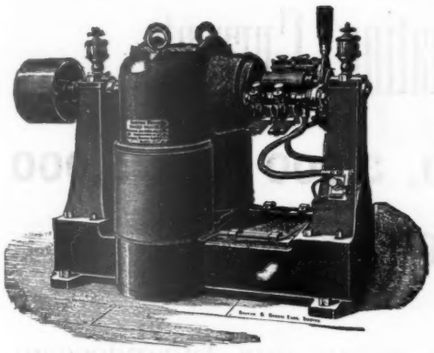

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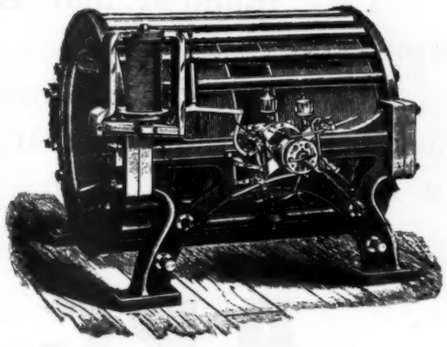

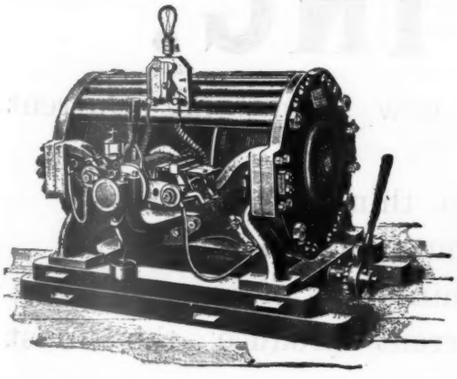

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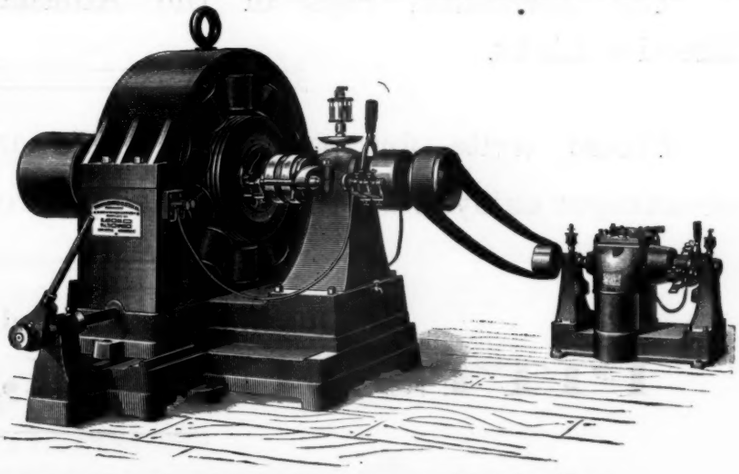

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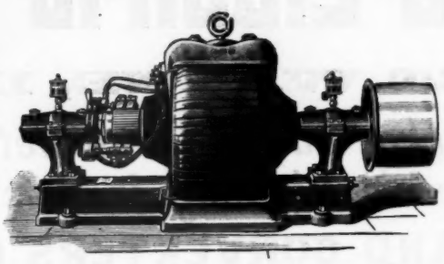

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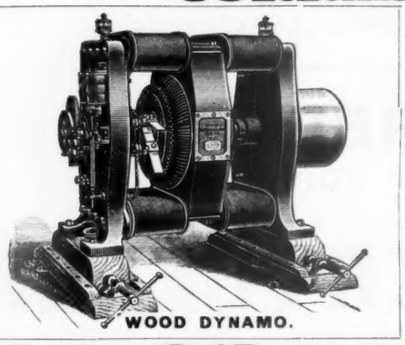

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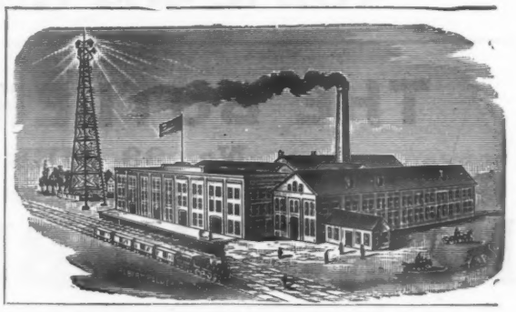

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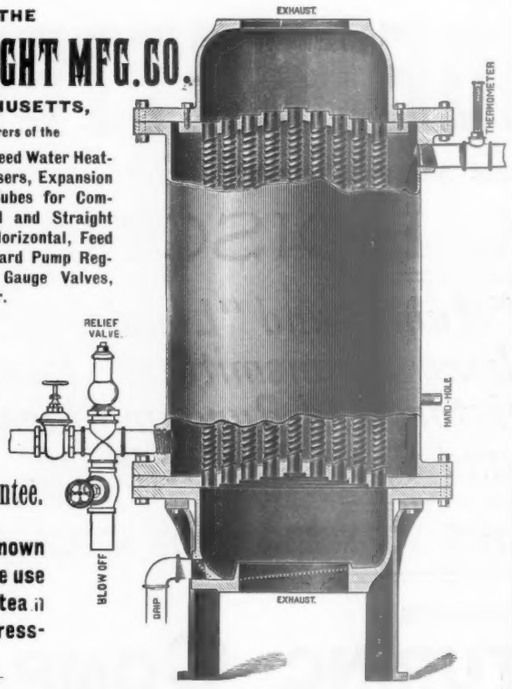

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